



Construction Services

City of Negaunee
Irontown Substation



Seth Packwood
5/16/23

Prepared by:

Power System Engineering, Inc.

May 16th, 2023

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** For Reference

END OF SECTION

SECTION 00 11 16 – ADVERTISEMENT

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

Furnish and deliver Construction Services
For City of Negaunee, Negaunee, Michigan

City of Negaunee, Negaunee, Michigan will receive sealed bids to furnish and deliver, including any necessary labor, materials, and equipment for the Irontown Substation.

Sealed Bids will be received at City of Negaunee City Hall, 319 West Case Street, P.O. Box 70, Negaunee, MI 49866, until June 13th, 2023 at 11:00 a.m. EST at which time the bids will be opened and publicly read aloud.

Bids shall be addressed to City of Negaunee, Attn: City Clerk, 319 West Case Street, P.O. Box 70, Negaunee, MI 49866 and shall be marked "SEALED BID – IRONTOWN SUBSTATION CONSTRUCTION SERVICES - Submitted by (Bidder's name)".

Specifications and bid documents may be examined at or obtained from the Consulting Engineering Firm: Power System Engineering, Inc., Attn: Jill Igl, 2424 Rimrock Road, Suite 300, Madison, WI 53713. Ph# 608-268-3574 or by email at iglj@powersystem.org. The bidding documents will be issued electronically.

No proposal will be accepted unless accompanied by a certified check or bid bond for at least five percent (5%) of the amount of the proposal, payable to the Owner.

The Owner reserves the right to reject any or all bids, to waive any informalities in a bid, and to make awards in the interest of the Owner.

Published by authority of City of Negaunee City Clerk, and duly authorized agent for City of Negaunee Public Works.

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SECTION 00 21 13 – INSTRUCTIONS TO BIDDERS

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

PART 1 - GENERAL

1.1 INDEX

- A. Part 1 - General
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1.2 CONTRACT TIME

- A. Identify the Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.
- B. The Owner requires the work of this Contract be completed as quickly as possible. Consideration may be given to time of completion when reviewing submitted Bids.

1.3 DEFINITIONS

- A. Bidding Documents: Contract Documents supplemented with Advertisement to Bid, Instructions to Bidders, Bid Form, bid securities, and other documents identified on the Table of Contents (Section 000110).
- B. Bid: Executed Bid Form and required attachments submitted in accordance with these Instructions to Bidders.
- C. Bid Price: Monetary sum identified by the Bidder in the Bid Form.
- D. The term "BIDDER" means one who submits a Bid directly to the Owner, as distinct from a Sub-bidder, who submits a Bid to a Bidder. The term "Bidding Documents" includes the Advertisement or Invitation to Bid, Instructions to Bidders, the Proposal

Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Proposals).

- E. The OWNER of this project is City of Negaunee and may also be referred to as the Purchaser or Buyer.
- F. The term "CONTRACTOR" or "SUPPLIER" shall be held to mean the firm which is given a Purchase Order and/or Contract for material purchase.
- G. The ENGINEER for this project is Power System Engineering, 2424 Rimrock Road, Madison, WI.
- H. The terms "Bid" and "Proposal" have the same meaning.

1.4 CONTRACT DOCUMENTS IDENTIFICATION

- A. The Contract Documents are identified as the Irontown Substation Construction Services specifications for City of Negaunee as prepared by Power System Engineering, Inc., located at 2424 Rimrock Road, Madison WI, 53713.

1.5 AVAILABILITY OF DOCUMENTS

- A. Bidding Documents may be obtained from the Engineer as stated in Advertisement to Bid.
- B. Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- C. Bidding Documents are made available only for the purpose of obtaining offers for this Project. Their use does not grant a license for other purposes.

1.6 EXAMINATION OF DOCUMENTS

- A. Bidding Documents may be viewed at the office of Power System Engineering, 2424 Rimrock Road, Madison WI, 53713. The Bidding Documents will be issued electronically.
- B. Upon receipt of Bidding Documents, verify that documents are complete. Notify the Engineer if documents are incomplete.
- C. Immediately notify the Engineer upon finding discrepancies or omissions in Bidding Documents.
- D. The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Section, that without exception the Bid is premised upon performing and furnishing the equipment required by the Contract Documents as may be indicated in or required by the Contract

Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the services.

1.7 INQUIRIES AND ADDENDA

- A. Direct questions in writing or via e-mail to the Engineer, at the office of the Engineer.
- B. Verbal answers are not binding on any party.
- C. It is the Bidder's responsibility to verify with the Engineer that all Addenda have been received prior to submitting a Bid.
- D. Submit questions not less than eight days before the date set for receipt of Bids. Replies will be made by Addenda.
- E. Addenda may be issued during the bidding period. Addenda will be sent to known Bidders. Addenda become part of the Contract Documents. Oral and other interpretations or clarifications will be without legal effect. Include resultant costs in the Bid Price.

1.8 BIDDER QUALIFICATIONS

- A. The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item of material or equipment may be furnished or used by the Contractor if acceptable to Engineer, application for such acceptance will not be considered by the Engineer until after the Effective Date of the Agreement or issuance of a Purchase Order.
- B. The Bidder shall include evidence of having satisfactorily provided similar services to similar users for at least five installations during the past five years.

1.9 SUBMISSION PROCEDURE

- A. Bidders shall be solely responsible for delivery of Bids in the manner and time prescribed in the Advertisement.
- B. Submit one copy of the executed offer on the Bid Forms provided, signed and sealed with the required security deposit in a closed opaque envelope, clearly identified with the Bidder's name, Project name, and Owner's name on the outside.
- C. Improperly completed information, irregularities in security deposit or Bid Bond, will be cause not to open the Bid Form envelope and declare the Bid invalid or informal.
- D. An abstract summary of submitted Bids will be made available to all Bidders following the Bid Opening.

1.10 BID INELIGIBILITY

- A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, or that contain arithmetical errors, erasures, alterations, or irregularities of any kind, will be declared unacceptable at the Owner's discretion.
- B. Bid Forms, Appendices, and enclosures which are improperly prepared will be declared unacceptable at the Owner's discretion.
- C. Failure to provide the security deposit, bonds, or insurance requirements will invalidate the Bid at the discretion of the Owner.

1.11 BID SECURITY

- A. Each Bid must be accompanied by Bid Security made payable to the Owner in an amount and in the form as defined in the Advertisement. If the amount of Bid Security is not defined in the Advertisement, the Bid security shall be five percent (5%) of the Bidder's maximum Bid Price and in the form of a certified or bank check or a Bid Bond (on form attached, if a form is prescribed) issued by a surety meeting the requirements. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of the authority to act. If the surety on any Bond furnished by the Bidder is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the above requirements, the Bidder shall within five days thereafter substitute another Bond and Surety, both of which must be acceptable to the Owner. The security deposit of the accepted Bidder will be returned after delivery to the Engineer of the required Performance Bond by the accepted Bidder.
- B. Bid, Performance, and Payment Bonds shall be issued by a surety company licensed to do business in the state of the Owner and Owner's project. The Performance Bond shall be equal to 100% of the contract price.
- C. The Bid Security is used as a guarantee that if the Proposal is accepted, the Bidder will execute and file three (3) completed copies of the required proper Contract and Performance Bond within fifteen (15) days after award of the Contract.
- D. The Bid Security of the successful Bidder will be retained until such Bidder has executed the Agreement or accepted the Purchase Order and furnished the required Contract Security, whereupon the Bid Security will be returned. If the Successful Bidder fails to execute and deliver the Agreement or accept the Purchase Order within fifteen days after the Notice of Award or issuance of Purchase Order, the Owner may annul the Notice of Award or Purchase Order and the Bid Security of that Bidder will be forfeited. The Bid Security of other Bidders whom the Owner believes to have a reasonable chance of receiving the award may be retained by the Owner until the earlier of the

seventh day after the Effective Date of the Agreement or the forty-sixth day after the Bid Opening, whereupon Bid Security furnished by such Bidders will be returned. Bid Security with Bids which are not competitive will be returned on acceptance of the Contract.

- E. If no Contract is awarded, security deposits will be returned.

1.12 BID FORM REQUIREMENTS

- A. Complete requested information in the Proposal Form and Bidding Documents.
- B. Provide additional Bid data as outlined in the technical specification.

1.13 SELECTION AND AWARD OF BIDS

- A. Bids will be evaluated and selected based on the lowest evaluated, responsible, acceptable total base Bid price with full consideration of alternates.

1.14 BID OPENING

- A. Bids will be opened publicly immediately after the time for receipt of Bids noted in the Advertisement or any Addendums adjusting the timeframe.

1.15 DURATION OF OFFER

- A. Bids shall remain open to acceptance for a period of 60 days after the bid closing date.
- B. No Bid shall be withdrawn after the opening of Bids without written consent of the Owner for a period of sixty (60) days after the scheduled time of receiving the Bids.

1.16 ACCEPTANCE OF OFFER

- A. The Owner reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time or changes in the work and to negotiate Contract terms with the successful Bidder and the right to disregard all nonconforming, non-responsive, unbalanced or conditional Bids. Also, the Owner reserves the right to reject the Bid of any Bidder if the Owner believes that it would not be in the best interest of the project to make an award to that Bidder, whether because the Bid is not responsive, or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Owner.
- B. After acceptance by the Owner, the Engineer, on behalf of the Owner, will issue to the accepted Bidder a written Notice of Award.
- C. The Owner may conduct such investigations as the Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, Suppliers and other persons and organizations to perform and furnish

the equipment in accordance with the Contract Documents to the Owner's satisfaction within the prescribed time.

- D. If the Contract is to be awarded, it will be awarded to the Bidder whose Bid offer, as evaluated by the Owner, indicates to the Owner that the award will result in the lowest overall project cost at completion and be in the best interests of the project and the Owner.
- E. Notwithstanding delay in the preparation and execution of the Agreement, the accepted Bidder shall be prepared, upon written Notice of Award, to commence work immediately following receipt of official written order of the Owner to proceed, or on a date stipulated in such order.
- F. The accepted Bidder shall assist and cooperate with the Owner to prepare the Agreement, and within fifteen days following its presentation shall execute the Agreement and return it to the Owner.

END OF SECTION

SECTION 00 41 13 - PROPOSAL

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

* All bids shall be in U.S. Dollars in lawful money of the United States of America.

TO: City of Negaunee (Hereinafter called the “Owner”)

1. Base Bid – Irontown Substation:

Quoted Price - Total Price to furnish and deliver the
substation construction as specified.

\$ _____

\$ _____ dollars, and _____ cents.

Exceptions to base bids shall be clearly identified on a separate sheet indicating any and all equipment that deviates from the specifications herein. The bidder may present exceptions to the base bid as an alternative bid and the Owner will evaluate and award the Contract with considerations to any exceptions to the base bid.

2. Alternate Bid – Suggested alternate, assuming the alternate items are acceptable:

Quoted Price - Total Price to furnish and deliver the
substation construction as specified.

\$ _____

\$ _____ dollars, and _____ cents.

The labor and equipment proposed is strictly in accordance with the specifications; if not, list all exceptions clearly on a separate sheet and identify them as such. (Yes/No) _____

Is sales tax omitted as specified in the base bid. (Yes/No) _____

3. Anticipated Schedule (by calendar days or date) After Notice of Bid Acceptance:

A. Approximate start of construction: _____

B. Anticipated lead time for site work to be completed: _____

C. Anticipated lead time to complete the installation: _____

4. Construction Unit Cost Breakdown:

A. Preliminary grading	\$ _____	
B. Fencing	\$ _____	
C. Foundations	\$ _____	
D. Conduit material & labor	\$ _____	
E. Ground grid material & labor	\$ _____	
F. Oil Containment material & labor	\$ _____	
G. Crushed stone surfacing	\$ _____	
H. Erection of substation steel structures	\$ _____	
I. Installation of substation bus work	\$ _____	
J. Transformer installation	\$ _____	
K. Equipment installation	\$ _____	
L. Control building	\$ _____	
M. Station battery system	\$ _____	
N. Station power, lighting, and wiring	\$ _____	
O. Wildlife protection material & labor	\$ _____	
P. Final grading	\$ _____	
Q. Miscellaneous contractor expenses	\$ _____	
R. Optional adder to change the specified fence fabric to a no cut, no climb security fence fabric.	\$ _____	
Total	\$ _____	

5. Cost Information for Reference – Per Unit Foundation Costs:

A. Foundation A – 138kV Switch Structure	\$ _____	each
B. Foundation B – 15kV Metering Stand	\$ _____	each
C. Foundation C – 15kV Distribution Structure	\$ _____	each
D. Foundation D – 15kV Riser Structure	\$ _____	each
E. Foundation E – 138kV Circuit Breaker Pad	\$ _____	each
F. Foundation F – 138kV Transformer Pad	\$ _____	each

- | | | |
|--|----------|------|
| G. Foundation G – 15kV Regulator Pad | \$ _____ | each |
| H. Foundation H – 15kV Recloser Pad | \$ _____ | each |
| I. Foundation I – Substation Control Building | \$ _____ | each |
| J. Foundation I – Alternate cost for complete Substation Control Building foundation using spread footings for perimeter and slab floor. If chosen, this cost would be added to the contract and item I above would be deducted. | \$ _____ | each |

6. Unit Adjustment Prices (prices for the following will be used as adders for additional material and deducts for items removed from the project):

A. Grounding (material & labor of installation)

- 1. Ground rod 5/8" X 10' (each) \$ _____
- 2. Ground conductor #4/0 CU (ft) \$ _____
- 3. Caldwell terminator #4/0 CU to "T" connection (each) \$ _____
- 4. Caldwell terminator #4/0 CU to "X" connection (each) \$ _____

B. Authorized grading additions (material & labor)

- 1. \$ per ton of breaker rock for site stabilization \$ _____
- 2. \$ per cubic yard for excavation \$ _____
- 3. \$ per cubic yard for granular backfill material \$ _____

C. Control cable (material)

- 5. 2/C #10 (per ft) \$ _____
- 6. 4/C #10 (per ft) \$ _____
- 7. 4/C #12 (per ft) \$ _____
- 8. 12/C #12 (per ft) \$ _____

D. Control cable terminations (material & labor of installation)

- 1. Control wire terminations (each) \$ _____
- 2. Volume discount (if any) \$ _____

7. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents and to furnish all materials, equipment, tools, supplies, transportation, utilities and all other items and facilities necessary to complete the work in accordance with the intent of the contract documents including specifications, drawings and all addenda issued by the OWNER prior to opening of proposals.

8. Bidder further agrees to complete all work required under the contract within the time stipulated in said specifications, and to accept in full payment therefore the prices(s) listed above.

9. The following Addenda have been received. The modifications to the Contract Documents noted therein have been considered and all costs thereto are included in the Bid Price.

Date	Addendum #
_____	_____
_____	_____

- (a) BIDDER has familiarized itself with the nature and extent of the Contract Documents, Work, Site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the materials and equipment.
- (b) BIDDER has given ENGINEER written notice of all conflicts, errors or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER.
- (c) BIDDER certifies that this proposal is made and submitted without fraud or collusion with any other firm or corporation whatsoever. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.
- (d) The BIDDER acknowledges the right of the OWNER to reject any or all Bids, waive any irregularities or informalities therein and award the Contract to other than the lowest evaluated Bidder if, in its discretion, the interests of the OWNER would be best served thereby.

10. City of Negaunee is a tax exempt entity. Tax exempt information can be provided to the successful bidder if required.

11. The following documents are attached to and made a condition of this Bid:

Required bid security in the form of a Certified Check or Bid Bond, being at least five percent (5%) of the amount bid, and made payable to the OWNER.

SELLER:

ADDRESS:

AUTHORIZED
REPRESENTATIVE:

SIGNATURE:

DATE:

TITLE:

TELEPHONE NUMBER:

Proposal contact person:

Email address of proposal contact
person:

Phone number of proposal contact
person:

END OF SECTION

SECTION 00 42 00 – BID BOND

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

BIDDER
(Name and Address):

SURETY
(Name and Address of Principal Place of Business):

OWNER (Name and Address)

City of Negaunee
319 West Case Street
P.O. Box 70
Negaunee, MI 49866

BID

BID DUE DATE: June 13th, 2023

PROJECT: Construction Services

BOND

BOND NUMBER: _____

DATE: (Not later than Bid Due Date): _____

PENAL SUM: _____

IN WITNESS WHEREOF, Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the following page hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER

(Seal)
Bidder's Name and Corporate Seal

SURETY

(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

By: _____
Signature and Title (Attach Power of Attorney)

Attest: _____
Signature and Title

Attest: _____
Signature and Title

Note: (1) Above addresses are to be used for giving required notice.
(2) Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents.
3. This obligation shall be null and void if:
 - a. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents, or
 - b. All Bids are rejected by Owner, or
 - c. Owner fails to issue a notice of award to Bidder within the time specified in the Bidding Documents (or any extensions thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of and any and all defenses based on or arising out of any time extension to issue notice of award agreed to in writing by Owner and Bidder, provided that the time for issuing notice of award including extensions shall not in the aggregate exceed 120 days from Bid Due Date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety, and in no case later than one year after Bid Due Date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the project is located.
8. Notice required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of the Bond conflicts with any applicable provision of any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein included a bid, offer or proposal as applicable.

END OF SECTION

SECTION 00 42 20 - PROPOSED SUBCONTRACTORS

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

List the name and address of all subcontractors who will perform work in relation to this contract:

Subcontractor

Work

NOTE: Failure to complete this list may result in rejection of bid. Statements such as “to be determined” are not acceptable.

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SECTION 00 52 00 – CONTRACT

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

THIS CONTRACT, made this ____ day of _____, by and between _____ hereinafter called the "CONTRACTOR", and City of Negaunee, 319 West Case Street, P.O. Box 70, Negaunee, MI 49866 hereinafter called the "OWNER".

WITNESSETH: That the Contractor and the Owner for the consideration stated herein agree as follows:

ARTICLE I, SCOPE OF WORK: The Contractor shall perform everything required to be performed and shall provide and furnish the labor, and/or equipment, materials, necessary tools, expendable equipment and all utility and transportation services required to:

furnish and deliver the construction of the Irontown Substation as defined in the specifications and drawings.

all in accordance with the drawings and specifications, including any and all addenda, prepared by POWER SYSTEM ENGINEERING, INC., "ENGINEER", which drawings and specifications are made part of this Contract; and in strict compliance with the Contractor's proposal and other component parts of the Contract Documents herein mentioned, which are a part of this Contract. The Contractor shall do everything required by this Contract including all the component parts of the Contract Documents constituting a part hereof.

ARTICLE II, CONTRACT PRICE: The Owner shall pay to the Contractor for the performance of this Contract, subject to any addition or deduction provided therein, in current United States funds, the amount of _____ Dollars and _____ Cents (\$_____). This said amount includes

Payments are to be made to the Contractor in accordance with and subject to the provisions embodied in the Contract Documents made a part of this Contract.

ARTICLE III, CONTRACT DOCUMENTS: The Contract Documents consist of the following component parts, all of which are as fully a part of this Contract as if herein set out verbatim or, if not attached, as if hereto attached:

1. All documents as outlined in the Table of Contents.
2. Agreed upon clarifications between the Owner and Contractor after receipt of proposal.
3. The Contractor's proposal.
4. All other documents affixed to this Contract.

In the event that any of the provisions in any of the above component parts of this Contract conflict with any provision in any other of the component parts, the provision in the component part first enumerated above shall govern over any other component part which follows it numerically, except as may be otherwise specifically stated.

ARTICLE IV, CONTRACT EXECUTION: This Contract is executed in triplicate.

IN WITNESS WHEREOF: The parties hereto have caused this instrument to be executed the day and year first above written.

CONTRACTOR:

Attest:

By _____

By _____

(CORPORATE SEAL)

(CORPORATE SEAL)

Print Name _____

Print Name _____

Title _____

Title _____

OWNER:

City of Negaunee
600 Cherry Street
Negaunee, MI 49866

Attest:

By _____

By _____ (Seal)

Print Name _____

Print Name _____

Title _____

Title _____

INSTRUCTIONS FOR EXECUTING THE CONTRACT

The full name and business address of the Contractor shall be inserted and the Contract shall be signed with an official signature. The name of the signing party or parties shall be printed legibly under all signatures to the Contract.

If the Contractor be a corporation the following certificate shall be executed:

I, _____, certify that I am the _____ secretary of the corporation named as

Contractor herein; that _____ who signed the foregoing Contract on behalf of the

Contractor was then _____ of said Corporation; that said Contract was duly signed for and in behalf of said Corporation by authority of its governing body, and is within the scope of its corporate powers.

By _____ (Seal)

Title _____

In lieu of the foregoing certificate there may be attached to the Contract, a certified copy of the resolution of the board of directors of the corporation evidencing the authority of such official to sign the Contract.

The Contract shall also bear the attesting signature of the secretary or the assistant secretary of the corporation, and impressions of the corporate seal where indicated if a seal exists. Contracts which are signed by the secretary of the corporation shall be attested by some other officer of the corporation. If the corporation has no seal, include a statement or notation stating that the corporation has no seal.

If the Contractor be a partnership, the trade name (if the Contractor be operating under a trade name) shall be indicated in the Contract and the Contract shall be signed by each partner. If the Contract is not signed by each partner, there shall be attached to the Contract, a duly authenticated power of attorney executed by the partners evidencing the signer's authority to sign such Contract for and in behalf of the partnership or the partner.

If the Contractor be an individual, the trade name (if the Contractor be operating under a trade name) shall be indicated in the Contract and the Contract shall be signed by such individual. If the Contract is signed by one other than the individual, there shall be attached to the Contract, a duly authenticated power of attorney executed by the individual evidencing the signer's authority to sign such Contract for and in behalf of the individual.

END OF SECTION

This page has been left intentionally blank.

SECTION 00 61 13 - PERFORMANCE BOND

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

KNOW ALL MEN BY THESE PRESENTS that

we _____

_____ as Principal, and _____

_____ as Surety, are held and firmly

bound unto _____ hereinafter

called the Owner, in the penal sum of _____ Dollars

(\$ _____) lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The Condition of the obligation is such that whereas the Principal has executed the attached Contract dated

_____, 2023, to:

Provide and furnish labor and equipment for the Irontown Substation – Construction Services per the plans and specifications.

NOW THEREFORE, if the Principal shall:

well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said Contract during the terms of said Contract and any extensions thereof that may be granted by the Owner, with or without notice to the Surety, and during the life of any guaranty required under the Contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the Surety being hereby waived; and

promptly make payment to all persons supplying labor and material in the prosecution of the work provided for in said Contract, and any and all duly authorized modifications of said Contract that may hereafter be made, notice of which modifications to the Surety being hereby waived;

then this obligation to be void, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bounden parties have executed this document under their several seals this

_____ day of _____, 2023, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In the presence of: Witness; _____ Individual Principal

By _____
(Seal)

By _____

Corporate Principal

Business Address

(Affix)

By _____ (Corporate)
(Seal)

Attest:

By _____

Title

Title

Corporate Surety

Business Address

(Affix)

By _____ (Corporate)
(Seal)

Title

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the _____ Secretary of the

Corporation named as Principal in the within bond, that _____

who signed the said bond on behalf of the Principal was _____ of said Corporation; that I know his signature, and his signature thereto is genuine, and that said bond was duly signed, sealed, and attested for in behalf of said Corporation by authority of its governing body.

By _____ (Affix)
(Seal) (Corporate)

END OF SECTION

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SECTION 00 61 14 – PAYMENT BOND

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

That “the **Contractor**,” _____, a corporation____, individual____, partnership____, joint venture____ of the State of _____, qualified to do business in the State of Michigan, as Principal, and “the Surety,” _____, of the State of _____, as surety, are held bound unto the City of Negaunee, “the **Owner**,” as Obligee, in the amount of _____ Dollars (\$ _____), for the payment of which the **Contractor** and Surety bind themselves, their respective heirs, successors, legal representatives and assigns, jointly and severally, in compliance with 1963 PA 213, as amended, MCL 129.201 et seq.

The Contractor has entered into “the Contract” with the **Owner** for _____ “the Work,” covered by the Contract Document which are incorporated into this Payment Bond by this reference:

If the Contractor promptly pays all claimants supplying labor or materials to the **Contractor** or to the **Contractor's** Subcontractors in the prosecution of the Work, then THIS OBLIGATION IS VOID, OTHERWISE TO REMAIN IN FULL FORCE AND EFFECT.

- A. All rights and remedies on this Payment Bond are solely for the protection of all claimants supplying labor and materials to the **Contractor** or the **Contractor's** Subcontractors in the prosecution of the Work, and must be determined in accordance with Michigan Law.
- B. No change in Contract Price or Contract Time, "or equal" or substitution or modification of the Contract Documents (including addition, deletion or other revision) must release the Surety of its obligations under this Payment Bond. The Surety hereby expressly waives notice of any such change in Contract Price or Contract Time, "or equal" or substitution or modification of the Contract Documents (including addition, deletion or other revision).
- C. It is the intention of the **Contractor** and Surety that they must be bound by all terms and conditions of the Contract Documents (including, but not limited to this Payment Bond). However, this Payment Bond is executed pursuant to 1963 PA 213, as amended, MCL 129.201 et seq., and if any provision(s) of this Payment Bond is/are illegal, invalid or unenforceable, all other provisions of this Payment Bond must nevertheless remain in full force and effect, and the **Owner** must be protected to the full extent provided by 1963 PA 213, as amended, MCL 129.201 et seq.

IMPORTANT: The Surety must be authorized to do business in the State of Michigan by the Department of Licensing and Regulatory Affairs - Insurance Bureau, must be listed on the current U.S. Department of the Treasury Circular 570, and, unless otherwise authorized by the Owner in writing, must have at least an A- Best's rating and a Class VII or better financial size category per current A. M. Best Company ratings.

Name, Address, and Telephone of the Surety

Address and Telephone of Agent, who is either a resident of, or whose principal office is maintained in the State of Michigan

Signed and sealed this ____ day of _____, 20__.

THE **CONTRACTOR**: (Print Full Name and Sign) By: _____

WITNESS _____

Name & Title: _____

Telephone No: _____

THE **SURETY**: (Print Full Name and Sign)

Agent: _____

WITNESS _____

Attorney-in-Fact: _____

Telephone No: _____

SECTION 00 65 20 – WAIVER AND RELEASE OF LIEN

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

WHEREAS, the undersigned, _____ has furnished to
manufacturer, materialman, contractor or subcontractor
_____ the following: _____
name of contractor kind of material and services furnished
in the construction of a project belonging to _____, known as
name of owner
_____.
project designation

NOW, THEREFORE, the undersigned, _____ (name of manufacturer,
materialman or subcontractor), for and in consideration \$_____, and other good and
valuable consideration, the receipt whereof is hereby acknowledged, do(es) hereby waive and
release any and all liens, or right to or claim of lien, on the above described project and premises,
under any law, common or statutory, on account of labor or materials, or both, heretofore or
hereafter furnished by the undersigned to or for the account of said _____ for
said project. name of contractor

Given under my (our) hand(s) and seal(s) this ____ day of _____, 2023.

name of manufacturer, materialman or subcontractor

By _____, president, vice president, partner or owner, or, if signed by other
than one of the foregoing, accompanied by power of attorney signed by one of the foregoing in
favor of the signer (use designation applicable).

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SECTION 00 72 00 – GENERAL CONDITIONS

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

PART 1 - GENERAL

1.1 INDEX

- A. Part 1 - General
 - 1. Index
 - 2. Intent of the Contract Documents
 - 3. Definitions
 - 4. Performance Bond and Payment Bond
 - 5. Assignment of Contract
 - 6. Chattel Mortgages
 - 7. Liens
 - 8. Contract Completion Date
 - 9. Termination for Breach of Contract
 - 10. Specifications and Submittals
 - 11. Record Data
 - 12. Equipment, Materials, and Workmanship
 - 13. Damages
 - 14. Authority of Engineer
 - 15. Payment to Contractor
 - 16. Delays
 - 17. Owner's Right to Withhold Payment
 - 18. Payment for Additional or Omitted Work
 - 19. Final Payment
 - 20. Deduction for Incorrect Work
 - 21. Correction of Work After Final Payment
 - 22. Royalties and Patents
 - 23. Warranties and Guarantees
 - 24. Compliance with Statutes and Regulations
 - 25. Supplementary Conditions

1.2 INTENT OF THE CONTRACT DOCUMENTS

- A. It is the intent of the Contract Documents to describe a functionally complete Project, or a portion thereof, to be furnished in accordance with the Contract Documents.
- B. The costs of equipment, materials, labor, documentation, supplies, and services as may be necessary to furnish the purchased equipment, materials, and/or labor of construction, except as expressly omitted, shall be included as part of the Work in the Contract Documents.
- C. Any equipment, materials, labor, documentation, supplies, and services that may reasonably be inferred from the Contract Documents, or from prevailing custom or trade

usage as being required to produce the intended result, shall be furnished whether or not specifically called for at no additional cost to the Owner.

- D. The Contract Documents are complimentary; what is called for by one is as binding as if called for by all.
- E. In interpreting the Contract Documents, words describing the Work that have a well-known technical or trade meaning, unless otherwise specifically defined in the Contract Documents, shall be construed in accordance with such well-known meaning recognized by architects, engineers, or the trade.
- F. These General Conditions will be included in the Contract Documents to furnish equipment, materials, labor of construction, or any combination thereof.

1.3 DEFINITIONS

- A. Definitions are described in the Instructions to Bidders.

1.4 PERFORMANCE BOND AND PAYMENT BOND

- A. The Performance and Payment Bonds shall be provided as described in the Instructions to Bidders.

1.5 ASSIGNMENT OF CONTRACT

- A. The Contractor may not assign the Work, or any portion thereof, without the Owner's written consent. No assignment will be valid unless it contains a provision indicating that funds to be paid to the assignee are subject to a prior lien for equipment, materials, and/or labor of construction furnished in performance of the Work, in favor of all persons, firms, or corporations furnishing such equipment, materials, and/or labor of construction.

1.6 CHATTEL MORTGAGES

- A. No equipment or material items may be purchased by the Contractor or a Subcontractor subject to a chattel mortgage or under conditional sale or agreement by which an interest is retained by the Seller. The Contractor warrants he will have good title to equipment and/or material items used in the Work.

1.7 LIENS

- A. If within thirty (30) days after the Work herein has been completed and accepted by the Owner any person claiming to have furnished equipment, materials, and/or labor of construction in completion of the Work has filed a lien or claim against the Contractor for said equipment, materials, and/or labor of construction, the Owner shall retain from monies under its control then due, or to become due under this Contract, such monies sufficient to pay off, satisfy, and discharge such lien or claim, together with the

reasonable cost of any such action or actions brought, or that may be brought, to enforce such claim or lien.

1.8 CONTRACT COMPLETION DATE

- A. Neither a time extension beyond the date affixed herein for completion of the Work, nor delivery of articles called for in the Work after the time herein specified for completion, shall be deemed to be a waiver of abandonment or delay in the manner herein provided and/or of the right to abrogate this Contract or to enforce other provisions of this Contract.

1.9 TERMINATION FOR BREACH OF CONTRACT

- A. In the event the Contractor or his Subcontractor violates a provision of the Contract Documents, the Owner may serve written notice upon the Contractor and the Surety of its intention to terminate such contract within ten (10) days after serving such notice. Such notice shall contain the reasons for intent to terminate the contract. In the event of termination, the Owner shall immediately serve notice thereof upon the Contractor and the Surety, and if the Surety does not commence performance thereof within thirty (30) days from the date of the mailing to such Surety of notice of termination, the Owner may take over the Work and prosecute the same to completion by contract for the account and at the expense of the Contractor, and the Contractor and his Surety shall be liable to the Owner for excess costs occasioned the Owner thereby, and in such event the Owner may take possession of and utilize in completing the Work such materials, appliances, and plant as may be on the site of the Work and necessary therefore.

1.10 SPECIFICATIONS AND SUBMITTALS

- A. The Work shall be executed in conformance with the specifications, drawings, and issued addenda that are included in the Contract Documents.
- B. The Contractor shall perform no Work prior to obtaining Engineer-approved submittals as specifically described in the Project Requirements and technical sections of the Contract Documents or as requested by the Engineer. Equipment, materials, and/or installation methods used without the Engineer's prior approval may be subject to rejection.

1.11 RECORD DATA

- A. The Contractor shall provide record data as specifically described in the General Requirements and technical sections of the Contract Documents or as requested by the Engineer.

1.12 EQUIPMENT, MATERIALS, AND WORKMANSHIP

- A. Unless otherwise stipulated in the Contract Documents, the equipment, materials, and Workmanship incorporated in the Work covered by this Contract shall be new and of the best grade of their respective types for the purpose. The Contractor will, if required,

furnish such evidence as to the type and quality of equipment, materials, and/or Workmanship.

- B. The equipment, materials, and Workmanship furnished under this Contract shall be furnished and performed in accordance with well known, established practices and standards recognized by architects, engineers, and the trade.

1.13 DAMAGES

- A. The Contractor shall pay all damages for injury to real or personal property, for any injury sustained by any person growing out of any act or deed of said Contractor, his Subcontractors, or of his or their employees, that is in the nature of a legal liability, and shall indemnify and save the Owner harmless against suits or actions of every name and description brought against said Owner for, or on account of, any such injuries to real or personal property, injuries received or sustained by any person or persons caused by said Contractor, his servants, agents or employees, in the execution of said Work or by or in consequence of any negligence in guarding his agents or employees, and the said Contractor further agrees that so much of the money due to him under and by virtue of this contract, as shall be considered necessary by the Owner, may be retained by the Owner to protect itself against loss until such suit or claim for damage shall have been settled, and evidence to that effect shall have been furnished to the satisfaction of the Owner.

1.14 AUTHORITY OF ENGINEER

- A. The Work contemplated and described in this Contract, and in the specifications, plans, profiles, and drawings, shall be done under the direction and supervision of and to the satisfaction of the Engineer, who shall be the sole judge as to the fitness of materials, and shall have the right of correcting errors or omissions in the Contract Documents when such corrections are necessary for proper completion of the Work herein stipulated and for the proper fulfillment of their intention, the action of such correction to date from the time the Engineer gives due notice not increase the respective prices herein set forth in the Owner Contractor Agreement.

1.15 PAYMENT TO CONTRACTOR

- A. For equipment and/or material contracts, the Contractor shall submit an invoice to the Owner after the equipment and/or material item(s) have been shipped as instructed with the record data as specified in the General Requirements and technical sections of the Contract Documents. The Engineer will review each invoice and make a recommendation regarding payment.
 - 1. Ninety percent (90%) of the prorated Contract amount on each item of equipment and/or group of materials will be paid within thirty (30) days after receipt of the equipment and/or materials or in the next scheduled monthly payment review period.
 - 2. Ten percent (10%) of the Contract amount will be paid within thirty (30) days after final testing is completed, the equipment is accepted by the Owner, and record data

as described in these General Conditions, General Requirements, and technical sections is received by the Engineer.

- B. For labor of construction contracts, the Contractor shall submit to the Owner an estimate of Work performed by the Contractor during a calendar month or a time agreed between the Contractor and the Owner. The Engineer will review each invoice and make a recommendation regarding payment.
 - 1. Ninety percent (90%) of each approved monthly billing will be paid within thirty (30) days of receipt or in the next scheduled monthly payment review period.
 - 2. Ten percent (10%) of each approved monthly billing will be retained until completion of the Work. Final payment will be made to the Contractor within thirty (30) days after the Work is completed to the satisfaction of the Owner and Engineer, and record data as requested in these General Conditions General Requirements and technical sections is received by the Engineer.

1.16 DELAYS

- A. If the Contractor is delayed in Work completion due to an act of neglect by the Owner or another contractor employed by the Owner, or due to strike, fire, unavoidable casualty, or cause beyond the Contractor's control, the time of completion shall be extended for a reasonable time. The Contractor shall, within five (5) days from the beginning of a delay, notify the Owner in writing as to the cause of such delay.

1.17 OWNER'S RIGHT TO WITHHOLD PAYMENT

- A. In addition to payment retained by the Owner under the preceding provisions of these General Conditions, the Owner may withhold payment otherwise due the Contractor as the result of:
 - 1. Payments earned or due for just labor or material legal claims pertaining to Work under this Contract.
 - 2. Defective Work not remedied.
 - 3. The Contractor's failure to make proper payment to his Subcontractor.
- B. The Owner may withhold from the Contractor payment due as may be necessary to protect the Owner from loss due to defective Work not remedied, injury to persons, or damage to the Work or property of others caused by an act of neglect by the Contractor or any of his Subcontractors. The Owner shall have the right, as agent for the Contractor, to apply such amounts so withheld as the Owner may deem proper to satisfy such claims or to secure such protection. Such application of money shall be deemed payment for the Contractor's account.

1.18 PAYMENT FOR ADDITIONAL OR OMITTED WORK

- A. Upon proper action, the Owner may authorize changes in, additions to, or deductions from the Work to be performed pursuant to provisions of the Contract Documents.
- B. Adjustment in an amount to be paid to the Contractor by reason of a change, addition, or deduction shall be determined by one or more of the following methods:

1. Unit pricing that was included the Contractor's Proposal form and incorporated into the Contract Documents.
 2. A supplemental price schedule that was included with the Contractor's Proposal form and incorporated into the Contract Documents.
 3. A proposal from the Contractor that is acceptable to the Owner.
- C. No claim for additional payment to the Contractor shall be valid unless authorized as aforesaid and by a written order of the Owner or the Engineer.

1.19 FINAL PAYMENT

- A. When the Contractor shows to the satisfaction of the Owner and the Engineer that liens, claims, and demands for payment of equipment, materials, and/or labor of construction costs are fully satisfied, that the Work completed is fully released from such liens, claims, and demands, and that the Contractor has completely performed the Work, the Engineer shall certify the same in writing. A lien waiver form is included as part of these Contract Documents and shall be completed for each primary Contractor or Subcontractor used for the Work. Each lien waiver shall be returned before final payment is released.
- B. When said certificate has been filed with the Owner, the Owner will pay to the Contractor the sum due out of the aforementioned fund set aside to meet and defray the expenses of such Work, the whole amount of money accruing to the Contractor for the Work, excepting such sum or sums as shall have been paid to the Contractor under the foregoing provisions of the Contract Documents and such as may be lawfully retained under the provisions of the Contract Documents, provided that no such certificate or payment for the Work shall be held to be an acceptance on the Owner's part of defective Workmanship or improper materials used by the Contractor in performance of the Work, or as waiver on the Owner's part of any claim or demands for, or on account of, such defective Workmanship or improper materials or as a waiver of a breach of the Contract Documents.

1.20 DEDUCTION FOR INCORRECT WORK

- A. If the Owner deems it expedient to accept Work injured or not done in accordance with the Contract Documents, the difference in value, together with a fair allowance for damages, shall be deducted.

1.21 CORRECTION OF WORK AFTER FINAL PAYMENT

- A. Neither final payment, nor a provision in the Contract Documents, shall relieve the Contractor of responsibility for negligence, faulty materials, or faulty Workmanship within the extent and period provided by law. Upon written notice, the Contractor shall remove defects due thereto and shall pay for damage due to other Work resulting therefrom which shall appear within one (1) year after the date of completion and acceptance.

1.22 ROYALTIES AND PATENTS

- A. The Contractor shall pay for royalties and patents, shall defend suits or claims for infringement on a patent right, and shall save the Owner harmless from loss on account thereof.

1.23 WARRANTIES AND GUARANTEES

- A. The Contractor shall furnish warranties and/or guarantees as specifically described in the General Requirements and technical sections of the Contract Documents.
- B. Delivery of warranties and/or guarantees shall not relieve the Contractor of obligations under the Contract Documents.

1.24 COMPLIANCE WITH STATUTES AND REGULATIONS

- A. The Contractor shall comply with applicable statutes, ordinances, rules, and regulations pertaining to the Work as prescribed by federal, state, or local governmental and administrative authorities.
- B. Each Bidder shall be responsible for consideration and verification of the site conditions, laws, construction methods, etc. that may affect the performance, warranty, or furnishing of the Work.

1.25 SUPPLEMENTARY CONDITIONS

- A. Refer to the Supplementary Conditions section for additional conditions if provided with the Bidding and Contract Documents.

END OF SECTION

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SECTION 00 72 01 – SUPPLEMENTARY CONDITIONS

CITY OF NEGAUNEE

IRONTOWN SUBSTATION – CONSTRUCTION SERVICES

PART 1 GENERAL

1.1 SUPPLEMENTARY CONDITIONS

- A. These Supplementary Conditions modify the General Conditions of the Contract for Construction, and other provisions of the Contract Documents as indicated below. All provisions which are not so modified remain in full force and effect.
- B. The terms used in these Supplementary Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

1.2 BASIC DEFINITIONS

1.2.1	Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
1.2.2	Furnish: To supply and deliver and inspect for damage.
1.2.3	Install: To unload, unpack, assemble, erect, apply, place, finish, cure, protect, clean, and make ready for use.
1.2.4	Provide: To furnish and install.

1.3 CONTRACTOR’S LIABILITY INSURANCE

- A. If the Contractor is providing labor of installing, unloading, or testing, the Contractor shall secure and maintain such insurance from an insurance company authorized to write casualty insurance in the State where the work is located as will protect himself, his Subcontractors and which shall indemnify and save harmless the Owner and the Engineer and their officers, agents, and employees from and against all claims for bodily injury, death or property damage which may arise from the Contractor’s operations under this Contract, whether such operations be by himself or any Subcontractor or by anyone directly or indirectly employed by the Contractor or Subcontractor.
- B. The Contractor shall not commence labor of installation, unloading, or testing under this Contract until he has obtained all insurance required under this section and shall have filed the certificate of insurance with the Owner and a copy with the Owner’s attorney. Each insurance policy shall contain a clause assuring the insurance company will not cancel the insurance without thirty days written notice to the Owner, the Owner’s attorney, and the Engineer of intention to cancel.

The amounts of such insurance shall be not less than the following, or greater if required by law:

1. Worker's Compensation:
 - a. State Statutory
 - b. Applicable Federal
 - c. Employer's Liability:
 - 1) \$100,000 Each occurrence

2. Commercial General Liability (including Premises-Operations; Independent Contractors' Protective; products and Completed Operations; Broad Form Property Damage):
 - a. Bodily Injury and Property Damage (Name Owner as additional insured):
 - 1) \$1,500,000 Each occurrence
 - 2) \$3,000,000 Annual aggregate
 - b. Products and Completed Operations to be maintained for two years after final payment.
 - c. Property Damage Liability Insurance shall provide X, C, or U coverage as applicable.
 - d. Contractual Liability to be included.

3. Comprehensive Carrier Vehicle Liability:
 - a. Bodily Injury:
 - 1) \$1,000,000 CSL Each Person
 - 2) \$(Included) Each Occurrence
 - b. Property Damage:
 - 1) \$(Included) Each Occurrence
 - 2) Note: The State of Minnesota has a no-fault vehicle insurance requirement. The Contractor shall be certain coverage is provided which conforms to any specific stipulation in the law.

4. Umbrella Excess Liability: Name Owner as additional insured:
 - a. Excess Liability:
 - 1) \$1,000,000 Over primary insurance
 - 2) \$10,000 Retention for self-insured hazards each occurrence.

1.4 STATE-FUNDED PROJECT PREVAILING WAGE REQUIREMENTS

- A. The Contractor (and its Subcontractors) represents and warrants that it pays all laborers employed directly on the site of the work, unconditionally and at least once a week, and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the advertised specifications as prevailing wages based on locality, regardless of any contractual relationship which may be alleged to exist between the Contractor or subcontractor and the laborers.

- B. The Contractor represents and warrants that Contractor will post the scale of wages to be paid in a prominent and easily accessible place at the site of the work.

END OF SECTION

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DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01 10 00 – INFORMATION AND
REQUIREMENTS

SECTION INDEX

1. Location of Project
 2. Scope of Project
 3. Owner-Furnished Materials and Labor
 4. Work by Others
 5. Permits and Regulations
 6. Applications for Payment
 7. Trade Names and Catalog References
 8. Progress Meetings
 9. Field Engineering and Staking
 10. Codes and Standards
 11. Submittals
 12. Construction Record Plans
 13. Tests
 14. Contract Closeout
 15. Schedule
 16. Construction Bid Unit Descriptions
-

1 LOCATION OF THE PROJECT

The Irontown Substation is located at the south end of Peninsula Street in Negaunee, Michigan. Coordinates of the substation are approximately 46°29'39.0"N 87°36'43.2"W.

2 SCOPE OF THE PROJECT

- 2.1 The project consists of the construction of a new substation known as the Irontown Substation. The scope of the project shall include providing necessary labor, tools, materials, and equipment required to construct the new Irontown Substation as detailed in the plans and specifications.

This substation is owned by the City of Negaunee; however, the 138kV incoming line will be configured as a flow-through as part of American Transmission Company's (ATC) transmission system. As such, the City of Negaunee will own and maintain the substation site as well as the high-side 138kV transformer disconnect switch & 138kV breaker through the 4.16kV circuits. ATC will own, operate, and install the 138kV flow-through facilities.

The City of Negaunee scope of work for the Irontown Substation includes, but is not necessarily limited to, the following:

- A. Preliminary grading
- B. Fencing
- C. Foundations
- D. Conduit material and labor
- E. Ground grid material and labor
- F. Oil containment material and labor
- G. Crushed stone surfacing
- H. Erection of substation steel structures
- I. Installation of substation bus
- J. Transformer installation
- K. Equipment installation
- L. Control building material & labor
- M. Furnish and install station battery system
- N. Station power, lighting, and wiring
- O. Wildlife protection material and labor
- P. Final grading
- Q. Miscellaneous Contractor expenses covering all other work and equipment necessary for a complete and operable facility.

The above listed items are described in greater detail in the construction bid unit descriptions later in this section.

- 2.2 A preliminary schedule for the project is defined later in this specification section.

- 2.3 The Contractor shall visit the site prior to bidding and shall be aware of site conditions and limitations including those bearing on transportation, storage, disposal, handling and other items which may impact the Contractor's construction activities.
- 2.4 The Contractor shall not perform work outside standard hours or as set forth by local ordinance which may limit start times, finish times and weekend work. The Contractor shall be responsible for verifying any time restrictions by local ordinances.
 - A. The perception of the Contractor's personnel could reflect on the City of Negaunee and as such the Contractor's personnel and Subcontractors shall act in a professional and courteous manner and shall take into consideration the concerns of the local residents.
 - B. If conflicts arise, the Contractor shall notify the Owner and Engineer immediately.
- 2.5 The Contractor shall follow their own safety guidelines for personnel safety, the City of Negaunee safety guidelines, and any other safety requirements.
- 2.6 The Contractor shall notify the City of Negaunee when arriving on the site and when leaving the site. This will be discussed during a preconstruction meeting and may consist of a general listing of what days/hours the contractor anticipates working.
- 2.7 Prior to the Contractor starting any work at the substation, the Contractor shall file an insurance certificate with the Owner for the work naming the Owner as additional insured if they do not already have one on file with the Owner.
- 2.8 The Contractor is responsible for contacting MISS DIG 811 for locating underground facilities.
- 2.9 The intent of the project is for the Contractor to install materials provided by the Owner and to provide and install additional materials for a complete and functioning installation.
- 2.10 The Contractor will be required to coordinate with the Owner, Engineer, ATC's Contractor, and other Contractors for a complete installation.

3 OWNER FURNISHED MATERIALS AND LABOR

The Owner will provide:

- 3.1 Substation transformer, 138 kV circuit breakers, regulators, reclosers, and relay panels. The transformer will be assembled by the transformer manufacturer with HV bushing lifting and arrester installation assistance from the Substation Contractor. All other Owner furnished items will be installed by the Contractor.
- 3.2 The lightning masts and substation material package will be furnished by the Owner under separate contract through a substation material packager. The preliminary

packager bill of materials is included for reference on drawing IRT-06-20 and IRT-06-21. Various individual items to be provided by the contractor may be marked on drawings 06-20 and 06-21 or the general arrangement drawings. Additional materials to be provided by the Contractor are provided on drawing IRT-05-04 and IRT-06-22.

- 3.3 New underground substation feeder exit distribution cables and terminations shall be furnished and installed by a distribution line contractor under separate bid/contract.
- 3.4 SCADA and telephone service, if required, will be provided, and installed by the Owner.
- 3.5 Building permits, storm water management and erosion control permits. A storm water management plan has been created for the Owner. The Contractor shall implement, maintain, inspect, and monitor the erosion control facilities at the substation as part of this contract

4 MATERIAL AND LABOR FURNISHED BY OTHERS

- 4.1 American Transmission Company (ATC) will be providing and installing their equipment and materials for the 138 KV flow through portion of the substation. This includes the ATC foundations, anchor bolts, ATC conduit, control wiring, above grade structures and equipment which is identified in the drawings.
- 4.2 Substation revenue metering will be provided by WPPI Energy for installation by the Contractor. Meter programming and verification will be completed by WPPI.
- 4.3 The Contractor is responsible for all material and labor except for the following:
 - A. Acceptance testing and commissioning.
 - B. Ground grid testing.
 - C. Any other items noted to be performed by someone other than the contractor.
- 4.4 The Contractor shall work in coordination with other Contractors including ATC's contractor, the Owner, the engineer, manufacturers, and others to complete the installation in a coordinated manner.

5 PERMITS AND REGULATIONS

- 5.1 Permits and licenses of a temporary nature necessary for the prosecution of the work shall be obtained and paid for by the Contractor, other than those noted as being provided by the Owner. The Owner shall assist the Contractor, when necessary, in obtaining such permits and licenses.
 - A. The Owner will obtain the building permit (if required) and the Erosion Control Storm Water Management Plan permit. All other permits are the responsibility of the Contractor.

- 5.2 The Contractor shall give all notices and comply with all laws, ordinances, building and construction codes, rules, and regulations applicable to the work. If the Contractor observes that the plans or specifications are at variance therewith, the Contractor shall promptly notify the Engineer.

6 APPLICATIONS FOR PAYMENT

- 6.1 Submit invoicing to the Owner on a monthly, quarterly or at the end of the project basis per the Contractor's typical invoicing timeframe. It is also recommended to send a copy of the invoice to the Engineer for review and recommendation for payment. Applications for payment shall show the scheduled value of each item, total completed from the previous application, work completed this period, total completed, and percent completed. A 10% retainage shall be applied to the invoicing until the project is complete. The Owner will process payments based on its normal payment cycle which is typically once a month. The payment timeframe will be reviewed with the successful bidder.
- 6.2 The cost breakdown from the unit prices in the Contractor's Proposal should be used for the price breakdown for payment.

7 TRADE NAMES AND CATALOG REFERENCES

- 7.1 References in the specifications or on the plans to a manufacturer's name, make, model or catalog number is intended to be descriptive as to type and quality of equipment and material required and is not necessarily intended to preclude the use of another make of equipment as material equal in quality and performance. Substitute equipment and materials will be considered under the following conditions:
- A. No manufacturer or product name specified: Any product meeting the specifications may be used. Provide approval data to the Engineer.
 - B. Manufacturer or product name(s), or equal, specified: Any product meeting the specifications may be substituted.
 - C. Manufacturer or product name(s), or approved equal, specified: Substitutes must be approved by the Engineer.
 - D. Manufacturer or product name(s) specified, without stating an equal or approved equal: no substitutions allowed. Furnish the product or one of the products specified.
- 7.2 The Contractor shall be responsible for investigating the proposed substitute and determining that it meets or exceeds the specified product, for coordination of installation, and for any other changes which may be required for the work to be complete in all respects. Provide approval data to the Engineer.

8 PROGRESS MEETINGS

At the request of the Owner and/or Engineer meetings may be held at the project site to determine the progress of the work, to receive instructions from the Engineer or the Owner and to expedite completion of the project. Subcontractors present at such meetings shall be represented by a person with full authority to act on behalf of the Subcontractor.

9 FIELD ENGINEERING AND STAKING

- 9.1 The Contractor shall provide field engineering services to establish grades, lines and levels using recognized engineering survey practices.
- 9.2 The Contractor shall notify the Engineer at least 48 hours in advance of initial field staking of base lines and grade so that, if desired, the Engineer can have a representative present to observe the results of the field staking.
- 9.3 The Owner reserves the right to change the placement of structures on the site at any time prior to start of the work and the Contractor shall not have any claims for any extras due to such changes; except, to compensate for any changes in quantities on excavation, fill, grading, and material required.

10 CODES AND STANDARDS

- 10.1 Laws, Codes and Regulations: The Contractor shall comply with, and the work shall be performed in compliance with all laws, ordinances, building and construction codes, rules, and regulations applicable to the work, including the following:
 - National Electric Safety Code (NESC)
 - National Fire Protection Association (NFPA)
 - National Electric Code (NEC)
 - Occupational Safety and Health Act (OSHA)
- 10.2 Standards: All equipment and materials shall be furnished, installed, and tested in conformance with the latest revisions of the following standards, as applicable:
 - American National Standards Institute, Inc. (ANSI)
 - American Society for Testing and Materials (ASTM)
 - Edison Electric Institute (EEI)
 - Institute of Electrical and Electronic Engineers, Inc. (IEEE)
 - Insulated Power Cable Engineers Association (IPCEA)
 - National Electrical Manufacturers' Association (NEMA)
 - Underwriters' Laboratories, Inc. (UL)
- 10.3 Conflicts: Where conflicts occur between codes and standards or between codes and standards and Specifications and Plans, the one establishing the more stringent requirements shall be followed.

11 SUBMITTALS

11.1 Construction Schedule:

- A. The Contractor shall within ten (10) days of award of the Contract submit a proposed construction schedule in the form of a bar chart, identifying the first day of each week. The chart shall show start and completion of activities of construction.
- B. The Contractor shall furnish with the construction schedule a list of delivery dates for materials furnished by the Contractor to be incorporated in the project.
- C. The construction schedule and the material delivery dates shall be updated as may be necessary during the course of the project because of changes in the schedule or delivery dates, or if requested to do so by the Engineer.

11.2 Welding Certificates:

The Contractor shall promptly after award of the Contract submit a copy of a welding certificate for each person assigned to do field welding on the project showing that the person has passed tests specified by the AWS. Certificates must be submitted prior to performing any welding. Certificates are not required for non-structural tack welding.

11.3 Shop Drawings and Product Information:

- A. The Contractor shall submit three sets or electronic copies of shop drawings and product information for the Engineer's review as soon as possible after award of the Contract, as required in each section of these specifications or as defined below.
- B. The Contractor shall provide submittals for all equipment and materials provided by the Contractor. Bill of materials, product catalog sheets, brochures, product manuals and miscellaneous items can be submitted as PDF files. Drawings such as structural steel details, erection drawings, anchor bolt plans, control building drawings, etc. (if part of this scope of work) can be submitted as PDF files during review. Closeout or record copies of drawings shall be provided in AutoCAD and PDF files. Other file types may also be acceptable and should be verified with the Engineer.
- C. The Contractor shall perform no work without submittals that have been approved by the Engineer. Equipment, materials and/or installation methods used without prior approval may be subject to rejection.
- D. The Contractor shall be responsible for checking shop drawings and product information prior to submittal for errors, correctness of details and conformance with the Contract, and for coordination between suppliers and Subcontractors.

The Contractor shall indicate with his submittal that he has checked and approved the shop drawings submitted.

- E. The Engineer's review of shop drawings and product information shall not relieve the Contractor from errors, omissions, correctness of details or dimensions, or conformance with the Contract. The Contractor shall make correction as required to obtain conformance with the Contract, whether such corrections are required during review or after fabrication, delivery or installation of the materials concerned.

12 CONSTRUCTION RECORD PLANS

The Contractor shall maintain during the course of the project a set of prints of the plans and other drawings (such as interconnection drawings) which shall be marked to show deviations from the Plans and Specifications for Construction. These plans and drawings shall be furnished to the Engineer for record when the construction is completed.

13 TESTS

- 13.1 The Contractor shall make tests and checks necessary to determine that connections are properly made, and that all apparatus functions satisfactorily. Notify the Engineer when an installation is considered to be complete and in operating condition, and ready for final tests.
- 13.2 When the installation will require final testing to be done by others, the Contractor shall furnish construction labor to disconnect and reconnect electrical or mechanical devices as required to perform such testing.

14 CONTRACT CLOSEOUT

- 14.1 The Contractor shall clean the site, picking up all trash and discarded material, sweeping paved areas and raking other surfaces.
- 14.2 The Contractor shall furnish the marked set of Construction Record Plans to the Engineer so that changes from the Plans and Specifications can be incorporated in the record drawings for the project.

15 SCHEDULE

- 15.1 The Contractor shall schedule his work to complete the substation construction in a timely manner. Scheduling items include, but are not limited to:
 - A. Attend a preconstruction meeting after the contract is awarded.
 - B. Begin foundation and other preliminary grading work as soon as possible.
 - C. The transformer is anticipated to be ready in the spring/summer of 2024 for delivery to the substation site. The Contractor will be responsible for unloading

the transformer onto the new foundations. The rest of the major equipment (circuit breaker, regulators, switches, reclosers, and relay panels) are anticipated to be available by spring/summer of 2024 with possible delivery to the substation site or an Owner designated storage location in Negaunee.

- D. Complete the substation as soon as practical based on equipment availability and as outlined in the Contractor's proposal.
 - E. The desired in-service date for the new substation is summer/fall 2024.
 - F. Final grading and landscaping in fall 2023 if possible.
- 15.2 The following delivery schedule is approximate and may change:
- A. December 2023 – New reclosers.
 - B. February 2024 – New 138kV main circuit breakers.
 - C. July 2024 – New transformer.
 - D. July 2024 – New regulators.
 - E. To be determined – Substation material package. This is currently out for bids with a bid opening of June 13th, 2023.
 - F. To be determined – Relay Panels.
- 15.3 The Contractor shall schedule work to be completed as soon as possible. The Contractor shall provide work schedule updates to the Engineer that includes timeframes and anticipated completion dates for this contract.
- 15.4 It is desired to complete all site related below grade work, fencing, etc. for a secure site before winter of this year.

16 CONSTRUCTION BID UNIT DESCRIPTIONS

The Contractor shall provide the following work items as outlined on the plans, in the specifications, and as listed below for the City of Negaunee's portion of the scope of work for the Irontown Substation:

- 16.1 **Preliminary Grading** – A lump sum cost is requested for preliminary grading, which shall include removal of vegetation, initial rough grading, fill placement, excavation, disposal of material, shoring, and removal of water (if applicable) as described in specifications and drawings.
- A. The Contractor shall be responsible for staking lines and grades as required for the substation construction and site work. Grades are shown on the plans.

- B. The contractor shall remove any excess materials such as gravel, fill, etc. to establish the grade. Disposal of these materials, if needed, will be accommodated on the overall substation property. Offsite disposal is not anticipated for soils.
- C. The Contractor shall install all erosion control/storm water management materials. The Contractor shall conduct weekly inspections of implemented erosion control and inspections after large rain events as outlined by the erosion control plan. A sample inspection form will be provided to the Contractor. Copies of the inspection forms shall be submitted monthly to the Owner.
- D. The Contractor shall be responsible for maintenance of all erosion control and storm water management materials. Permitting applications are provided by others.
- E. It should also be understood that the work will need to be installed in phases for a coordinated installation. The Contractor shall coordinate their work activities with the Owner and others.

16.2 **Fencing** – A lump sum cost is requested to provide and install fencing around the substation.

- A. The fencing is an 8-foot-tall chain link fence and gates, plus barbed wire at an additional height.
- B. The main gate shall include a personnel gate within the overall main gate.
- C. Intermediate fence posts shall be no further than 8 feet apart for wind loading considerations in the event plastic slats are added in the future.
- D. The new fence shall be bonded to the new ground grid.
- E. The corner posts, end posts, the post adjacent to a corner or end post and all gate posts shall be tubular and concreted in place per the plans and specifications. For the base bid the intermediate posts shall be concreted in place. An alternate deduct can be listed by the contractor for driven intermediate posts for consideration by the Owner and Engineer.
- F. The fence work should be completed as soon as possible to secure the site due to its remote location and to protect any ongoing installation.
- G. If temporary fencing is required, this shall be considered a part of the project and shall not incur additional cost.
- H. The new fencing shall be installed such that no bottom portion of the fence is above the finished grade. See fence drawings for details.
- I. The Contractor shall coordinate their fence work activities with the Owner and others.

- J. The Contractor shall ensure that all gates are properly locked using a Contractor's lock and an Owner's lock so as not to leave the substation fence open at any time while unattended.
- K. The Contractor shall provide review and record submittals for the fence.
- L. The Contractor shall coordinate the installation of fencing as needed to keep the site secure and meet all safety requirements.
- M. Fence signs are to be provided and installed by the Contractor. Anticipated signs are shown on drawing 02-11 and listed within section 26 05 00.

16.3 Foundations – A lump sum cost is requested to provide and install foundations.

- A. The Contractor shall provide and install anchor bolts for the substation equipment, control building, and any other anchor bolts not provided by others. Anchor bolts for the building will be coordinated with the building provider. The anchor bolts for the substation steel structures are being provided by the substation packager/steel supplier to be installed by the Contractor. Anchor bolts and templates delivery is to be determined and will be coordinated with the Contractor. Hammer epoxy and/or drill in wedge anchor bolts will be provided by the Contractor for the breakers, regulators, and reclosers.
- B. The Contractor shall be responsible for proper alignment of the anchor bolts for structures, equipment, and buildings.
- C. The Contractor shall stake the foundations and shall coordinate construction with other trades, the Engineer, and the Owner.
- D. A geotechnical report is included with the specification for reference. The Contractor shall coordinate the foundation installation with the Engineer so that a geotechnical engineer can be present to inspect the soil at footing grades to verify the bearing capacity assumed during design.
- E. Per unit foundation costs are also requested in the proposal. These may be used to add or deduct work accordingly based on possible changes in the project.
- F. The Contractor shall prepare concrete test cylinders and test results. Results shall be submitted to the Engineer.

16.4 Conduit Material & Labor – A lump sum cost is requested to provide and install conduit.

- A. The Contractor shall supply all conduit sticks, elbows, fittings, and miscellaneous items for installation of the conduit. The conduit installations shall be complete, to allow for control wiring to all equipment.

- B. All conduit locations are to be coordinated with the equipment to be installed for above grade connection to enclosures, etc. Avoid unnecessary bends and elbows.
 - C. The contractor shall supply the direct buried junction boxes described on the conduit plan drawing IRT-03-10.
 - D. Drawing IRT-03-10 shows the anticipated conduit locations. The conduit schedule for the City of Negaunee's portion is included in drawing IRT-03-10. All conduit locations are approximate and may need to be field adjusted for a coordinated installation.
- 16.5 **Ground Grid Material & Labor** – A lump sum cost is requested to provide and install the substation ground grid.
- A. The materials and installation shall include all ground grid, ground rod couplers, ground rod driving studs, grounding tails, fence grounding, connections, and other required grounding.
 - B. A list of materials is included on the Bill of Materials drawing IRT-06-22. The list is not 100% complete. The Contractor will be responsible for the quantity of material necessary for a complete installation. The Contractor shall provide additional bill of materials detail for review by the Engineer.
 - C. Furnish and install miscellaneous above grade grounding and connectors not provided by others to equipment junction boxes, control cabinets, etc. including all grounding within the control building.
 - D. The Contractor shall provide, install, and ground the substation ground mats as shown on drawing IRT-03-20.
 - E. Ground grid testing will be completed by others. Testing the ground grid resistance to remote earth will be done using the three-point fall of potential method. Testing shall be coordinated so it can occur before the oil containment, crushed stone surfacing or distribution neutrals are installed or connected. If results are above 2.0 Ohms, additional grounding may be installed per the direction of the Engineer. If additional grounding is required, it shall be handled by change order.
- 16.6 **Oil Containment Material and Labor** – A lump sum cost is requested to provide and install the oil containment system as detailed on the plans and specifications. This is the total cost for the containment for both substation transformers.
- 16.7 **Crushed Stone Surfacing** – A lump sum cost is requested to provide and install the crushed stone surfacing as detailed on the plans and specifications.
- A. Crushed stone surfacing shall include stone for the driveway covering as shown on the plans.

- B. Crushed stone shall extend up to 1 foot beyond the ground grid perimeter.
 - C. The crushed stone surfacing shall include 9 inches of crushed stone with fines and compacted to a firm, unyielding condition, other than in the area of the oil containment. The remaining crushed stone covering of the substation shall be 3 inches of clear crushed stone without fines to allow for surface water drainage in an effort to reduce any ponding within the substation. A total of a minimum of 12 inches of stone surfacing (9 inches with fines + 3 inches clear) is required.
 - D. Crushed stone within the drive area shall be compacted to an unyielding condition to allow for heavy truck traffic such as a crane or tractor trailer with loaded transformer. At a minimum this shall be accomplished by driving a fully loaded dump truck through the drive areas and compacting until there is no discernable deflection.
- 16.8 **Erection of the Substation Steel** – A lump sum cost is requested to install the substation steel provided as part of the new material package.
- A. This work shall include installing the steel structures provided by the material packager.
 - B. This work shall include receiving, unloading, inventorying, storing, and assembly of the steel provided by the material packager.
 - C. Hole drilling, if required, will be the responsibility of the Contractor.
- 16.9 **Installation of Substation Bus Work** – A lump sum cost is requested to install the substation bus work.
- A. This includes the installation of switches, insulators, arresters, stranded or solid conductor, bus pipe, angle bus, current transformers, potential transformers, connectors, and miscellaneous components for a complete electrical installation.
 - B. All switches shall be completely adjusted and have all piercing bolts pierced and complete.
 - C. This work shall include loading, transporting, unloading, and inventorying all materials received and stored at the substation.
- 16.10 **Installation of Substation Transformer** – A lump sum cost is requested to install the substation transformer.
- A. The transformer manufacturer is anticipated to deliver the transformers directly to the substation site. The Contractor shall be responsible for unloading the transformers to the foundations. The Contractor shall be responsible for acquiring crane and rigging services as needed. Each transformer weighs approximately 76,700 lbs.; however, outline drawings will be provided when they are available from the manufacturer.

- B. The transformer manufacturer cannot guarantee that both transformers will make it to the site at the same time.
- C. Testing of the transformer will be performed by others.
- D. The Contractor shall assemble the transformer including installation of bushings, arresters, radiators, makeup oil, etc., following manufacturer installation manuals and requirements for warranty purposes. Personnel completing this work must have a record of successfully completing transformer assembly and references as to such.
- E. While the base bid has the Contractor completing transformer assembly, an alternate may option may be possible for the Owner to have the manufacturer or a testing firm on site to complete the assembly and testing. It is anticipated that the Contractor will have equipment on site for lifting radiators, bushings, etc. and will assist the testing firm/manufacturer with lifting materials to be installed by the testing firm.
- F. The Contractor will work in coordination with the manufacturer, Owner, Engineer, and others for a coordinated installation.

16.11 **Equipment Installation** – A lump sum cost is requested to install the substation equipment. A general outline of items is included below.

- A. The Contractor shall install the 138kV main breakers, regulators, feeder reclosers, all relay panels, service power transformer(s), and other miscellaneous equipment provided by the Owner or by others under separate contract as outlined in the plans and specifications for a complete installation.
- B. Installation shall include any transportation by the contractor from an Owner storage location, such as Negaunee’s utility building on Cherry Street, in the event equipment is received when the contractor is not present or available to receive equipment.
- C. Equipment installation shall follow manufacturer instruction manuals and utility best practices for substation installations.
- D. Testing of the equipment will be by others.

16.12 **Control Building** – A lump sum cost is requested to provide and install the control building as specified in Section 13 01 21 and as shown on the plans. The Contractor shall list the subcontractor providing the control building for approval by the Owner and Engineer.

- A. The base bid shall include a complete prefabricated or assembled on site (site built) building as detailed on the plans and in the specifications.

- B. The installation shall be complete including all equipment and materials other than those specifically noted as provided by the Owner or by others.
 - C. It is preferred to have the control building in place as soon as possible to accept delivery of loose components and securely store components.
 - D. The building manufacture/Contractor shall provide design calculations and engineering or architectural certification for the building provided by the Contractor.
 - E. The Contractor shall provide color and texture samples for the Owner to review and choose the building color scheme.
 - F. The Contractor and control building manufacturer shall verify the foundation in the plans is acceptable for the building that is being provided. If a different foundation is required, the Contractor shall provide clarification and cost information with the bid.
 - G. The Contractor may provide alternate bids such as block buildings, prefabricated concrete buildings, or other buildings which could be acceptable to the Owner. These items shall be listed as alternate bids. Details for any alternate control buildings shall be provided with the proposal for evaluation.
- 16.13 **Station Battery** – A lump sum cost is requested to furnish and install a complete substation battery system. Details are included on the plans, specifications and in Section 26 33 00, Battery and Charger. The batteries are anticipated to be sealed batteries reducing the need for ventilation due to concerns of hydrogen discharge.
- 16.14 **Station Power, Lighting, and Wiring** – A lump sum cost is requested to furnish and install the station power, lighting, and wiring.
- A. This includes control building wiring not included as part of the control building manufacturers cost, wiring within the substation yard, alarm wiring, service power wiring, cable as outlined on the cable schedule drawing IRT-04-01 and IRT-04-02, and all other wiring for a complete and functioning substation. This includes all junction boxes, terminal blocks, fuse blocks, fused disconnects, meter sockets, etc., for a complete wiring installation.
 - B. Install the wiring to the relay panels furnished by the Owner. The relay panels shall be bolted to the floor.
 - C. All “field wiring” to the 138 kV breakers, transformers, regulators, reclosers, lighting and other components for a complete installation.
 - D. All wires will be terminated in equipment, panel boards, relay panels, or other locations as required for a complete installation by the Contractor, unless

otherwise specified. The contractor shall assume every wire has a terminal and is connected to a terminal block, fuse block, etc.

- E. Substation yard lighting fixtures will be provided and installed by the Contractor. See drawing 06-21 for fixture information. Installation shall include items as needed to mount light fixtures, light bases, the wiring of the fixtures to the AC power, and all other items necessary for a functioning installation. The Contractor shall furnish and install all light supports light fixtures as required by the light manufacturer's requirements.
 - F. Install the primary and backup station service power transformers along with primary fusing. The Contractor shall be responsible for all primary and secondary wiring.
 - G. Equipment wiring diagrams will be provided by the Engineer during construction.
- 16.15 **Wildlife Protection Material & Labor** – A lump sum cost is requested to furnish and install wildlife protection.
- A. Wildlife protection will consist of disks, covers, insulating tape or tubing, and other items as provided in the Bill of Materials included as Exhibit 1 in this specification.
 - B. The items will be used to protect bushings, switches, arresters, transformer bushings, jumpers, etc. to reduce the risk of animal contacts in the substation.
- 16.16 **Final Grading** – A lump sum cost is requested to provide final grading.
- A. This includes spreading topsoil, removal of excess soil, seeding, sidewalk repair (if needed), and any other items needed to complete the grading.
 - B. Final grading is desired to be completed by October 1, 2023, if possible. If seeding is not established this shall be addressed in the growing season for 2024.
 - C. Additional landscaping such as trees, bushes, etc., will be provided and installed by others or addressed as a change order request.
- 16.17 **Miscellaneous Contractor Expenses** – A lump sum cost is requested.
- A. Examples of miscellaneous items include performance bonds, payment bonds, per-diems, lodging, insurance, transportation permits if needed, filling out construction site erosion control inspection forms, sanitation facilities, contractor storage facilities, contractors' insurance, and other miscellaneous items needed for a complete installation.
 - B. **NOTE** – The construction/installation is anticipated to have several starts and stops based on equipment delivery, coordination with ATC's contractor(s), and

other considerations. Charges for mobilization/demobilization are part of the base bid and are not a reason for change order/additional cost.

16.18 Unit Adjustment Prices – Unit costs adjustments are requested for various items which can be used as adders or deducts for changes in the project.

- A. Grounding per unit prices is requested in the proposal. Costs are for the material and installation of each item.
- B. Control Cable – Per foot costs for various control cables are requested. If additional cables are added or removed, these costs will allow the Owner to compensate the contractor for the cable. Installation costs for additional cables will be negotiated because the cost can vary depending on when the additional cables are installed.
- C. Control Cable Terminations - The cost for additional control cable terminations or volume of control cable terminations is requested if additional cables are installed. This cost may be used as part of the evaluation.
- D. Authorized Grading Additions (material and labor additions):
 - 1. Cost per ton of breaker rock for site stabilization. This cost is used only if after review by the Owner's Geotechnical Engineer it is determined that foundation bottoms or other soils are unsuitable. Breaker rock would be placed at the direction of the Geotechnical Engineer and the cost for this material and installation would be added to the contract. An estimate of the amount of material needed will be determined and agreed upon before an adder is given. Final cost will be based on the actual quantity installed.
 - 2. Additional excavation per cubic yard. This cost is used only if after review by the Owner's Geotechnical Engineer it is determined soils are unsuitable or unknown obstructions are encountered and additional excavation is needed beyond what is already called for on the plans and in the specifications.
 - 3. Additional backfill of granular material. This cost is used only if after review by the Owner's Geotechnical Engineer additional excavation was authorized and additional granular materials are needed. An estimate of the amount of material needed will be determined and agreed upon before an adder is given. Final cost will be based on the actual quantity installed.

END OF SECTION

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DIVISION 3 - CONCRETE

SECTION 03 01 00 - CAST-IN-PLACE CONCRETE

SECTION INDEX

1. General
 2. Codes and Standards
 3. Submittals
 4. Concrete Materials
 5. Concrete Design and Use
 6. Concrete Tests
 7. Reinforcing Steel
 8. Forms
 9. Installation
 10. Concrete Finishes
 11. Grouting Mortar
 12. Measurement and Payment
-



A handwritten signature in black ink, appearing to read "B. C. Giltner", written over a horizontal line.

May 3, 2023

1 GENERAL

This section applies to all concrete, including cast-in-place concrete, including footers, foundations, slabs, etc., and grouting mortar. Specific permission to pour must be obtained from the Owner and the Engineer prior to placement of any concrete. Permission will be granted only after all items to be embedded are in place, inspection of forms and reinforcing has been completed, and all required tests for design mix have been satisfactorily completed and approved.

2 CODES AND STANDARDS

Work shall be in accordance with applicable codes and standards of the following organizations:

- American Society for Testing and Materials (ASTM).
- American Concrete Institute (ACI).
- The edition of the ASTM standards or ACI codes shall be those applicable to the 2015 Michigan Building Code.
- Codes and standards shall be those applicable to the 2015 Michigan Building Code.

3 SUBMITTALS

- 3.1 Tests or certificates of compliance with standards specified, for each bar size of reinforcing steel.
- 3.2 Tests or certificates of compliance with standards specified, prior to commencing concrete placement for:
 - 3.2.1 Cement: from each car from which cement will be used.
 - 3.2.2 Aggregates: for each size aggregate from each source of aggregate, for grading, deleterious substances and soundness.
 - 3.2.3 Grout: technical data sheets for grout including instructions on mixing, placing, and curing.
- 3.3 Testing laboratory reports required prior to commencing concrete placement for each class of concrete and each size aggregate:
 - 3.3.1 Proposed concrete design mix.
 - 3.3.2 Tests on concrete cylinders from trial batch or proposed mix as listed under "Concrete Tests," this Section.

- 3.4 Testing laboratory reports for tests on concrete cylinders taken in field as listed under "Concrete Tests," this Section. Laboratory shall stamp each report stating whether or not test results indicate materials comply with specifications.
- 3.5 Reinforcing steel shop drawings in accordance with ACI 301, latest edition, chapter 5 (submitted prior to the fabrication of reinforcing steel).
- 3.6 Prepare a record of the transit-mix deliveries which document the time, location, and contents of each pour. This record shall be kept at the job site and made available to the Owner and the Engineer for inspection upon request.

4 CONCRETE MATERIALS

4.1 Cement

Cement shall be Portland Type I or Type I/II and shall conform to ASTM C150.

4.2 Aggregate

Aggregate shall consist of a mixture of coarse and fine aggregates.

4.2.1 Fine Aggregate

Fine aggregate shall consist of a well-graded mixture of natural or manufactured sands graded to the following limits and conforming to ASTM C33:

<u>Sieve</u>	<u>% Passing</u>
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 30
No. 50	5 to 30
No. 100	0 to 10

4.2.2 Coarse Aggregate

Coarse aggregate shall be a well-graded mixture of broken stone or crushed gravel conforming with ASTM C33, grading No. 67 (maximum size = 3/4") and shall be free of vegetable or organic matter, soft or friable particles, material finer than a No. 200 sieve, or any coal, lignite of lightweight materials.

4.3 Water

Water shall be clean, fresh, and free from injurious amounts of oil, alkali, acid, salts, organic materials, or other substances that may be deleterious to concrete or steel.

4.4 Admixtures

- 4.4.1 Water-reducing and set-controlling admixture, ASTM C494, Type A, D, or E as required. Use for all concrete.
- 4.4.2 Air entraining agent, ASTM C260. Use in accordance with manufacturers' recommendations. Use for all concrete.
- 4.4.3 Fly Ash: ASTM C618; all concrete mixes may be designed to include fly ash in the amount of approximately 15 percent or 20 percent of the cement by weight.

4.5 Storage of Materials

- 4.5.1 Cement: keep clean, dry, and free from weather damage.
- 4.5.2 Aggregates: stockpile each gradation separately on clean, non-contaminating surface.

5 CONCRETE DESIGN AND USE

5.1 Strength Classifications:

<u>Class</u>	<u>Required 28-day Compressive Strength</u>
A	4,000 psi

5.2 Minimum Cement Content

Use the pounds of cement per cubic yard of concrete to meet the requirements of 5.1 Strength Classifications and for work exposed to freeze-thaw conditions or to receive steel-troweled finish.

5.3 Maximum Water-Cement Ratio

The water-cement ratio shall not exceed 0.53 by weight. Since air entrained concrete is being used throughout the project a water cement ratio of .45 is recommended.

5.4 Air Entrainment

Air entrainment is required for concrete exposed to weather this includes mat foundations for equipment. Total air content (percent by volume) shall be $6\% \pm 1\%$

5.5 Workability

Proportions of the concrete shall produce a mixture, suited to placement methods, which will work readily into corners and angles of forms and around reinforcement and embedded items. Segregation of materials or free water will not be permitted.

Slump of concrete: use minimum practical; vary within limits given to suit placement conditions; in no case is slump to be increased by addition of water in excess of design mix quantity:

<u>Type of Construction</u>	<u>Maximum Slump (In.)</u>
Foundation walls and footings	3 - 5
Caissons, drilled shafts & cast-in-place piling	-See ACI 336.1 3 - 5
Slabs, beams and walls	3 - 5
Sidewalks, driveways, and slabs-on-grade	

5.6 Concrete Use

Class A: use for all concrete.

6 CONCRETE TESTS

6.1 Strength Tests

- 6.1.1 Comply with ASTM C39 for testing and ASTM C31 or C192 for preparation of cylinders.
- 6.1.2 Trial batches for mix designs: test three specimens at seven days and three at 28 days for each mix design. Certified copies of test results for mix designs performed within the preceding six-month period, for same aggregates and cement for mix producing strengths equal to required average compressive strengths from an established central plant may be submitted for approval in lieu of conduction new trial batch tests. If tests from previous work are not acceptable, prepare trial batch tests as specified.
- 6.1.3 Field Tests: Concrete test cylinders shall be made by the Contractor in accordance with ASTM C172; to provide for two sets of strength tests (a minimum of four cylinders) from each 50 cubic yards or fraction thereof placed in any one day. For a given class of concrete, if frequency of testing specified above would provide less than five samples, sample at least five randomly selected batches or each batch if five batches or fewer are required.
- 6.1.4 One set of cylinders shall be laboratory cured and an additional set of cylinders shall be field cured for testing purposes. Test one laboratory cured cylinder at seven days and two cylinders at 28 days for average strength. The fourth cylinder would be available for later testing should the strength requirement not be met.
- 6.1.5 If tests indicate deficient strength, as defined by ACI 318-14, immediately adjust mix to increase average of subsequent test results and, when directed, carry out drilled core testing, ASTM C42 and/or load tests or fourth cylinder test required to establish that load-carrying capacity of structure is not jeopardized. If concrete fails

to meet structural design requirements, promptly remove and replace. Testing and remedial work shall be at no cost to the Owner.

6.1.6 Each cylinder shall be marked with identification number, record date, class of concrete, location in the structure, slump, truck ticket number, air temperature, and other data that may be required by the Owner and the Engineer.

6.1.7 The Contractor will retain an independent laboratory to perform all concrete tests on prepared field cylinders specified herein. Cost of transportation to laboratory and strength tests will be borne by the Contractor. The Contractor shall provide test results to the Owner and the Engineer.

6.2 Slump Tests

6.2.1 Test each batch as delivered; comply with ASTM C172 and C143.

6.2.2 If slump does not meet specifications, promptly remove batch from work and dispose of off-site at location specified by the Contractor. Under no circumstances is water to be added to batch after slump test.

7 REINFORCING STEEL

- Bars: ASTM A615, Grade 60.
- Ties: ASTM A615 Grade 60
- Welded Wire Reinforcement: ASTM A1064.
- Bend bars cold to conform to required details. Conform to ACI-315.
- Remove scale, loose flaky rust, dirt and other coatings, which would impair bond; space and tie in position shown.
- Space and tie securely in position. Welding is not permitted.
- The reinforcing steel cages shall be placed in the drilled pier foundation holes immediately after holes have been inspected and approved.
- Steel reinforcement placement and bends shall meet the tolerances listed in ACI 117.

8 FORMS

8.1 Construction

8.1.1 Use metal, exterior type plywood or exterior type plywood-lined forms for exposed surfaces. Erect true to line and grade, brace and tie securely, and make joints sufficiently tight to prevent mortar leakage. Form tolerances shall meet the requirements of ACI 117.

8.1.2 Provide one-inch chamfer at exposed edges.

8.1.3 Provide construction joints only where shown. Construction joints shall be keyed joints, except where shown otherwise.

8.2 Surface Treatment

Coat wood forms with non-staining mineral oil before placing reinforcing; treat surfaces of metal forms as recommended by manufacturer before placing reinforcing.

8.3 Form Stripping

Do not remove supporting forms and shoring until concrete has acquired sufficient strength to safely support own weight plus construction loads.

Minimum stripping time after placing concrete:

- Footings: 24 hours.
- Walls and piers: 48 hours.
- Self-supported beams and slabs: 14 days.

9 INSTALLATION

9.1 Reinforcing Bars

Reinforcing bars shall be cut and bent to conform to detail requirements shown on the Drawings. Bending radii shall no be less than three bar diameters. Bars shall be accurately placed, secured in place with approved chairs, tied with soft iron wire not less than 16-gauge. Splices or laps shall be as noted on the drawing but in no case shall a lap splice be less than required by ACI 318-14 for Class B lap splice. Bars shall be free of excess rust, mill scale or coatings, which would reduce or destroy bond. The minimum concrete covering over steel shall be two inches on formed sides and tops and three inches on bottoms. Where not detailed or otherwise specified, reinforcing bars shall be installed in accordance with the minimum requirements of ACI 318.

9.2 Mixing and Placing

9.2.1 All equipment for mixing and transporting concrete shall be clean with no ice, debris or residue from previous batches. Ready or transit mixed concrete shall be mixed and delivered in accordance with ASTM C94. Proportioning methods used shall insure that each batch is uniform and in accordance with the approved design mix. The Owner and the Engineer shall have the option of inspecting at any time the preparation of concrete to be used on this project. Concrete whose temperature exceeds 90°F will not be acceptable. Concrete shall be delivered to the site of work and discharged within one-half (1/2) hour after introduction of water to the mixer.

- 9.2.2 Concrete shall be transported to the site by equipment designed for that purpose and which will prevent segregation, separation or loss of material.
- 9.2.3 Before placement of concrete, all equipment, forms, reinforcement and other surfaces with which the concrete will come in contact shall be cleaned and thoroughly wetted, all debris, ice and water removed and the area where concrete is to be placed (forms) shall be thoroughly wetted except in freezing temperatures. However, no standing water shall be permitted. Concrete shall be placed as nearly as practicable in its final position to avoid separation due to rehandling. Concrete shall be placed at such a rate that it at all times is plastic and flows readily between bars. Concrete shall not be allowed to drop more than six (6) feet to its final location. Chutes shall be used to place the concrete. No concrete contaminated by foreign material shall be used, nor shall re-tempered concrete be used. Immediately after placement, the concrete shall be compacted by vibration to ensure that all air pockets and voids are eliminated. The vibration equipment shall be operated by experienced personnel and over vibration shall be avoided.
- 9.2.4 Before concrete is placed into the drilled foundation piers, the bottoms of the drilled holes shall be cleaned, inspected and leveled.
- 9.2.5 Each excavation for a drilled foundation shall have the base soil mechanically compacted to a firm, unyielding condition such that no settlement of the foundation will result. As a minimum, a 4x4 timber of at least five feet longer than the hole depth shall be rammed a minimum of 50 times onto the base of the excavation. Care shall be taken to prevent the disturbance of side soils and to uniformly cover the base area of the excavation. Each ramming shall consist of lifting the timber at least three feet and dropping it with a physically applied downward force.
- 9.2.6 Concrete shall be placed in the drilled foundation piers by providing a steel funnel-type hopper over the center of the drilled pier, depositing concrete vertically in the shaft. It is imperative that the concrete does not rebound off the earth wall of the drilled piers or the reinforcing steel.

9.3 Curing

Concrete shall be kept moist for at least five days after placing by water sprays, wetted burlap or other methods acceptable to the Owner and the Engineer. In hot weather, sunshades, fog sprays or other acceptable means shall be employed to prevent concrete temperature from exceeding 90°F. Curing compounds, if utilized, shall be used in accordance with the manufacturer's instructions. Curing compounds shall be Protex Triple Seal or equal.

9.4 Temperature Control

Concrete shall be mixed and placed when the temperature is at least 40°F and rising. Suitable means shall be provided for maintaining the concrete at a temperature of at least 50°F prior to and during mixing, in transit, during placement and for at least 72

hours after placement. Maintain minimum concrete temperature above 32°F for five additional days. The methods proposed for heating the materials and protecting the concrete shall be approved by the Owner and the Engineer. Salt, chemicals, or other foreign materials shall NOT be mixed with the concrete to prevent freezing. Accelerating agents will not be allowed.

10 CONCRETE FINISHES

10.1 Monolithic (Steel Trowel) Finish

All interior floor slabs shall be finished by tamping the concrete to force the coarse aggregate away from the surface, then screeding and floating with straight edges to bring the surface to the required finish level shown on the Drawings. While the concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be troweled to produce a hard, dense, smooth surface free of trowel marks. Additional troweling shall be given to the surface for the purpose of burnishing. The final troweling shall produce a ringing sound from the trowel.

10.2 Rough Slab Finish

Concrete apron slabs shall be prepared by tamping the concrete to force the aggregate away from the surface, then screeding with straight edges and floating to produce a reasonably true and uniform surface. Aprons shall be finished with a stiff broom to produce a coarse grain, non-skid surface. Apron edges shall be neatly finished to a minimum radius of one-half inch with a rounded-edging tool.

10.3 Equipment Pad Finish

Concrete pads for transformers, circuit breakers and similar equipment shall be given a monolithic (steel trowel) finish as specified above.

10.4 Exterior Foundation Finish

Exterior foundation walls and structure foundations shall be free of fins and honeycombing. Patch honeycomb, aggregate pockets, voids and holes as follows:

10.4.1 Chip out until solid concrete is exposed to minimum depth of one inch.

10.4.2 Prepare patching mortar with approximately two parts normal Portland cement, one part white cement, nine parts fine aggregate; vary proportions of cement as necessary to match color of adjacent concrete.

10.4.3 Saturate surfaces with water and fill cavities with patching mortar.

11 GROUTING MORTAR

Grouting mortar, if required for placement under equipment and metal-work, shall be in accordance with this paragraph.

11.1 Materials

The following brands of grout are acceptable for use: Five Star Grout as manufactured by Five Star Products, Non-Shrink General Purpose Grout Product No. 1585-01 as manufactured by Quickcrete, or Engineering approved equivalent.

11.2 Mixing, Placement, and Curing

Mixing, placement, and curing of grout shall be per the manufacturer's instructions.

12 MEASUREMENT AND PAYMENT

12.1 Concrete and rebar measurement and payment to be per the terms of the contract.

END OF SECTION



GEOTECHNICAL INVESTIGATION

FOR

PROPOSED IRONTOWN SUBSTATION

NEGAUNEE, MICHIGAN

SEPTEMBER 16, 2022

CEC PROJECT NO. GD-220452

COLEMAN ENGINEERING COMPANY

CIVIL ENGINEERING • ENVIRONMENTAL ENGINEERING
GEOTECHNICAL ENGINEERING • SURVEYING

GEOTECHNICAL INVESTIGATION
FOR
PROPOSED IRONTOWN SUBSTATION
NEGAUNEE, MICHIGAN
SEPTEMBER 16, 2022
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Prepared By:

COLEMAN ENGINEERING COMPANY
200 E. Ayer Street
Ironwood, Michigan 49938



COLEMAN ENGINEERING COMPANY

CIVIL ENGINEERING • ENVIRONMENTAL ENGINEERING • GEOTECHNICAL ENGINEERING • SURVEYING

200 EAST AYER STREET • IRONWOOD, MI 49938 • PHONE: 906-932-5048

September 16, 2022

Ms. Nicole Hall
Power System Engineering, Inc.
10710 Town Square Drive NE, Suite 201
Blaine, MN 55449

Re: Geotechnical Investigation
Proposed Irontown Substation
Negaunee, Michigan

Dear Ms. Hall:

Coleman Engineering Company (CEC) has completed the geotechnical investigation for the above referenced project. The enclosed geotechnical report includes a summary of the field and laboratory activities associated with the investigation.

We appreciate the opportunity to serve you. If you have any questions about our report, please feel free to call me in our Ironwood office at (906) 932-5048 or via email at gstengard@coleman-engineering.com.

Sincerely,

COLEMAN ENGINEERING COMPANY

Garth C. Stengard, P.E.
Geotechnical Engineering Manager

GCS/ks

Enclosure

CEC Project No. GD-220452

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APPENDIX B.	CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (UNIFIED SOIL CLASSIFICATION SYSTEM)
APPENDIX C.	SOIL EXPLORATION-GENERAL NOTES AND LEGEND
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I. INTRODUCTION

Power System Engineering, Inc. is proposing to construct a new Substation for the City of Negaunee, Michigan. The construction will likely consist of a new building, transformers, H-frame structures and general yard structures supported on either drilled pier or slab foundations. The purpose of this report is to document/summarize the results of the field investigation and to provide recommendations/guidance for foundation vertical/lateral support, settlement mitigation, groundwater management, earthwork quality assurance/control (QA/QC) and other relevant geotechnical considerations.

II. FIELD PROCEDURES

The site of the proposed substation was proposed to be evaluated with eight (8) soil borings drilled to a depth of 40 feet and were designated as Borings SB-1 through SB-8. All of the borings terminated at shallower depths due to bedrock.

The borings were advanced with a Diedrich D-50 all-terrain drill unit present on site August 19 through August 29, 2022. Drilling was performed utilizing 4 ¼-inch hollow stem augers (HSA), 3 7/8-inch mud rotary drilling methods and NQ-size bedrock coring.

The HSA act as continuously-advancing steel casing to prevent the borehole walls from collapsing in above the depths to be tested/sampled. Sampling tools are lowered inside the augers for testing into undisturbed soils ahead of the tip of the augers.

Mud rotary drilling consists of advancing soil borings using a rotary bit designed to allow drilling fluid to flow through the bit. Bentonite based drilling mud is pumped through the bit to flush soil cuttings to the surface as the bit advances. At each sampling interval, the roller bit is removed and sampling tools are lowered to the undisturbed soils.

Drilling and field sampling were performed in accordance with ASTM D-1586, "Penetration Test and Split Barrel Sampling of Soils" with a 2-inch O.D. split spoon. Fifty-four (54) such samples were obtained.

Bedrock was sampled using NQ-sized double tube coring methods in accordance with ASTM D-2113, "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation." Bedrock coring consists of a double tube configuration which allows a spinning outer barrel with a diamond impregnated bit to cut the rock while an inner barrel remains stationary to receive the core sample. Coring is conducted in increments or "run" of five feet. At

the end of a run, the inner barrel is lifted to the surface using a winch or “wire-line.” Bedrock core is removed from the inner barrel and placed in waxed cardboard core boxes. The core is labeled with respect to boring identification, orientation and depth. Spacers are placed in the core boxes to prevent samples from shifting during transport. Upon removal and labeling of the rock core, the inner barrel is replaced and coring resumes.

A field log was prepared for the borings during exploration which contained the work method, standard penetration test (SPT) data, samples recovered and the indication of the presence of various soil and rock types. The field logs were submitted to CEC’s Iron Mountain laboratory along with the soil and bedrock samples for evaluation of the subsurface information and preparation of the final boring logs.

The boring locations were selected by Power System Engineering, Inc. and established in the field by Coleman Engineering Company’s (CEC) drill crew. Ground surface elevations at the boring locations were not part of our scope of work. The project/boring location drawings are presented in Appendix A.

III. LABORATORY PROCEDURES

All field samples collected were visually classified in accordance with ASTM D-2488 “Description and Identification of Soils” (Visual-Manual Procedure). The bedrock cores were observed for bedrock classification and measured to determine the Rock Quality Designator (RQD) and Rock Mass Rating (RMR), ASTM D-5878-08, “Using Rock-Mass Classification Systems for Engineering Purposes” and ASTM D-5731, “Point Load Strength Index of Rock.” The RQD is defined as the sum of rock core pieces 4-inches in length or greater in a given coring run divided by the run length and multiplied by 100. The RMR is a rating system that assigns a rating to the rock core based on six (6) parameters: strength of intact rock material by point load test; RQD; spacing of joints; condition of discontinuity; presence of groundwater; and rating adjustment for discontinuity orientations. The point load strength of rock is a simple test to indicate the strength of rock. Selected core samples were tested for Point Load Strength to provide a representative unconfined compressive strength in conjunction with determining the RMR. Point – Load Strength Index of Rock test results and the rock core photographs are presented in Appendix F.

The final log contains both factual and interpretive information. It should be emphasized that the recommendations are based only on the final boring log. On the final log, horizontal lines

designating the interface between differing materials encountered represent approximate boundaries. The transition between soil layers is typically gradual.

IV. SITE CONDITIONS

The borings encountered 0.1 to 0.3 feet of topsoil at the surface. Undocumented existing fill consisting of poorly graded sand was encountered in Borings B-3, B-7 and B-8 to a depth of 2 feet below the existing ground surface. Below the topsoil or existing fill, native granular soils consisting of poorly graded sand (SP), poorly graded sand with silt (SP-SM), clayey sand (SC) and silty sand (SM) were encountered to depths of 9.5 to 13 feet. Below the native granular soils, four (4) of the borings encountered native lean clay (CL) to depths of 14 and 16.7 feet and two (2) borings encountered weathered bedrock to depths 20.2 to 28.6 feet. The native granular soils were in a medium dense to very dense condition. The native clays were very stiff to hard in consistency. The weathered bedrock was very dense. The soils contained varying amounts of gravel, cobbles and boulders.

All of the borings met auger drilling refusal at depths ranging from 12.9 to 28.6 feet. Bedrock was cored in Borings B-1 and B-8. The RQD values in the bedrock ranged from zero to eighteen percent (0% to 18%) corresponding to very poor rock quality. The RMR values ranged from 13 to 18 corresponding to a very poor rock rating.

Measurable groundwater ranged from not being observed while drilling to depths of 12 to 17 feet below the existing ground surface. Groundwater levels may fluctuate several feet seasonally, owing to rainfall, snowmelt, surface runoff, and other factors.

V. ANALYSIS AND RECOMMENDATIONS

Our analysis and recommendations related to the geotechnical aspects of the proposed project include:

Site Preparation and Grading

We recommend that any existing fill, topsoil or deleterious materials be stripped/excavated from within foundation footprints or equipment pads to a lateral distance equal to the depth of removal below the foundation (oversize 1 horizontal:1 vertical). Excavations should extend a minimum of 12 inches below the bottom of footing elevation to allow for a minimum of 12 inches of lightly compacted open graded aggregate such as Michigan Department of

Transportation (MDOT) 6A, or similar, completely enveloped in a geotextile (Mirafi 140N or similar).

All subgrade exposed after stripping/excavation should be evaluated by a geotechnical engineer or person under the direction of a geotechnical engineer. The evaluation should include shallow hand auger borings and/or dynamic cone penetrometer tests to determine if the native subgrade soils are similar to those encountered in the soil borings and suitable for support of fill and structure loads.

The native sub-grade exposed after stripping/undercutting is recommended to be compacted to a minimum of ninety percent (90%) of modified Proctor maximum dry density prior to commencing any backfilling operations.

Engineered fill is recommended to be placed where backfill is required and should consist of sand and/or gravel with less than about eight percent (8%) by weight of fines passing the No. 200 sieve with a maximum rock size of about 4 inches. A soil meeting MDOT specifications for Class II or IIA sand would be acceptable for use as engineered fill. Fill shall be placed in lifts not exceeding about 12 inches in loose thickness compacted to a minimum of ninety-five percent (95%) of modified Proctor (ASTM D-1557) maximum dry density.

Shallow Foundations

We recommend that the proposed building and equipment pads be supported on conventional spread footings founded on native soils, 12 inches of open graded stone or engineered fill. Footings so supported can be proportioned for a net allowable soil bearing pressure of up to 4,000 psf. The net allowable soil bearing pressure refers to that pressure in excess of the final overburden pressure. The recommended net allowable bearing pressure can be increased by one-third for short-term transient type live loadings. For the recommended design soil bearing pressure, we estimate a total settlement of less than 1 inch for column footings and for a 25-foot span of continuous wall footing. Differential settlement is expected to approach fifty to seventy-five percent (50 to 75%) of the total settlement for similarly sized and loaded footings.

Unheated equipment pads should extend to a minimum depth of 60 inches or full depth below the frost line or designed as a structural slab supported on drilled piers or shallow foundations with a sufficient void space between the slab and subgrade to prevent frost heave from negatively impacting the slab. Frost should not be allowed to penetrate below footings.

Drilled Pier Foundations

Estimated average soil parameters for the generalized subsurface profile were considered typical for this site and are presented in Appendix E, Table 1 – Design Parameters. The values in Table 1 do not include a safety factor.

Unit resistance values are presented in Table 2 – Design Capacities in Appendix E. The unit resistance values in Table 2 do not include a factor of safety. For the provided unit resistance values, we estimate a total settlement of less than 1 inch.

Unheated equipment pads should extend full depth below the frost line or designed as a structural slab supported on drilled piers with a sufficient void space between the slab and subgrade to prevent frost heave from negatively impacting the slab. Frost should not be allowed to penetrate below footings.

Underground Utility Construction

Soil types encountered during utility installation will be native soil. Based on the borings, the native soils encountered at depth are generally suitable for utility support. If over-excavation is required, we recommend that the unsuitable soils be removed a lateral distance equal to the depth of removal (1 foot horizontal to 1 foot vertical) below the utility line and replaced with engineered fill. In the event that unstable soils are encountered, it may be necessary to sub-cut these soils 1 to 3 feet (depth to be determined by field observation) and replaced with engineered fill in order to provide a stable work surface. Engineered fill placed below utility lines should be compacted to a minimum of ninety-five percent (95%) modified Proctor density (ASTM D-1557).

Within the limits of the substation, all trench backfill should be compacted to a minimum of ninety-five percent (95%) of modified Proctor density. Trench backfill should be placed in lifts not exceeding about 12 inches in loose thickness depending on the size of the compactor. Excavated soils are recommended for trench backfill above the pipe bedding material if they are at or can be brought, with reasonable effort, to the moisture content optimum for compaction as defined by the modified Proctor test (ASTM D-1557). If this is not the case, we recommend that all excavations be backfilled with a soil recommended by a geotechnical engineer familiar with site subsurface conditions. Backfill to at least 12 inches above the pipe crown (pipe bedding) should consist of MDOT Class II or IIA sand.

Chunks of frozen soil, organics, rock particles larger than about 4 inches and other deleterious

materials should not be permitted in trench backfill material. All utility pipes that could be negatively impacted by freezing should be located below frost depth. Frost depth in road areas is expected to be greater than in off-road areas. Trench spoil, heavy equipment and any type of vibrating machinery should not be permitted within a lateral distance from the top of the trench/excavation equal to 0.5 times the depth of the trench/excavation.

Caving of trench sidewalls and soils at the site should be expected to occur at any depth and without warning. All utility trenches should be cut back or braced as required to provide safe trench working conditions. Trench safety is the responsibility of the utility contractor.

Inspection and Testing

A qualified testing laboratory should be retained throughout the course of earthwork operations for testing and documentation of compliance with the recommendations of this report and related project specifications.

As a guide, the following compaction testing schedule is recommended:

Area or Material To Be Tested	Recommended Minimum Testing Frequency
Native Subgrades	1 test per 2,500 sq. ft.
Engineered Fill	1 test per 2,500 sq. ft. per lift

The inspection of the drilled pier is critical to verify the subsurface conditions and construction methods. The inspection should be performed by CEC. The following inspections should be documented:

- Diameter and depth of drilled pier.
- Occurrence and thickness of cemented deposits. The drilled pier length may need to be extended depending on the actual subsurface conditions.
- Occurrence and thickness of soft, loose soils and/or voids. The drilled pier length may need to be extended depending on the actual subsurface conditions.
- Any offset of drilled pier from design location.
- Plumbness of shaft.
- Date and time drilling was completed.
- Date, time, and amount of slough of final cleanout (shaft cleanout immediately prior to the placement of reinforcing and concrete).
- Date and time reinforcing cage placed.

- Date and time concrete placement started and completed.
- Tremie plugged and extend to the base of the pier prior to concrete placement.
- Actual and theoretical concrete volume.

Construction Considerations

We anticipate that the sidewalls of excavations to depths greater than 4 feet below surrounding grades will cave to 1 vertical to 1.5 horizontal or flatter. Excavation spoil, heavy equipment and any type of vibrating machinery should not be permitted within a lateral distance from the top of the excavation to 0.5 times the depth of the excavation. Excavation safety is the excavation contractor's responsibility.

During construction, adequate provision should be made for proper drainage, so as to prevent erosion and possible damage to this site and adjacent property. Temporary cut slopes during construction above the water table should not exceed about 2:1 (horizontal:vertical). Post-construction finished slopes above the water table should not exceed about 3:1 (horizontal:vertical).

In the event construction takes place during freezing conditions, precautions should be taken to prevent frost from penetrating below exposed foundations. Exposed subgrade should be free of frost prior to placement of fill. Engineered fill containing ice chunks or frozen soil should not be incorporated in an engineered fill.

VI. LIMITATIONS OF SUBSURFACE EXPLORATION

Services performed by Coleman Engineering Company as part of this investigation have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. No other warranty, expressed or implied, is made.

Subsurface conditions away from the borings will probably vary from those encountered at the locations where the borings were made. The data, interpretations and recommendations contained herein are based solely on the information obtained from the eight (8) soil borings completed for this study.

The conclusions and recommendations contained in this report are based on the assumption that the materials encountered in the boring represent the site conditions. If any unforeseen difficulties or unusual conditions are encountered, Coleman Engineering Company should be contacted immediately in order to make supplemental recommendations.

This report completes our present assignment for this project. As the design nears completion, we recommend that you consult with us on unanticipated problems or questions regarding the design and/or review of any plans or specifications. The work assignments for the above services are subject to your prior approval and authorization.

OUR CONCLUSIONS AND RECOMMENDATIONS ARE PREDICATED ON OBSERVATION AND TESTING OF THE EXCAVATION AND FOUNDATION PREPARATIONS BY QUALIFIED PERSONNEL. IT WOULD BE LOGICAL FOR COLEMAN ENGINEERING COMPANY TO PROVIDE THAT SERVICE, SINCE WE ARE BEST ABLE TO DETERMINE IF THE CONDITIONS ENCOUNTERED MATCH THOSE USED IN OUR ANALYSES, TO DETERMINE IF MODIFICATIONS OF OUR RECOMMENDATIONS ARE NEEDED AND TO MAKE SUCH MODIFICATIONS OF OUR RECOMMENDATIONS AS MAY BE NECESSARY. MODIFICATIONS OF OUR RECOMMENDATIONS BY OTHERS RELIEVE US OF RESPONSIBILITY FOR THEM.

This report has been completed by Garth C. Stengard, a registered engineer in the State of Michigan.



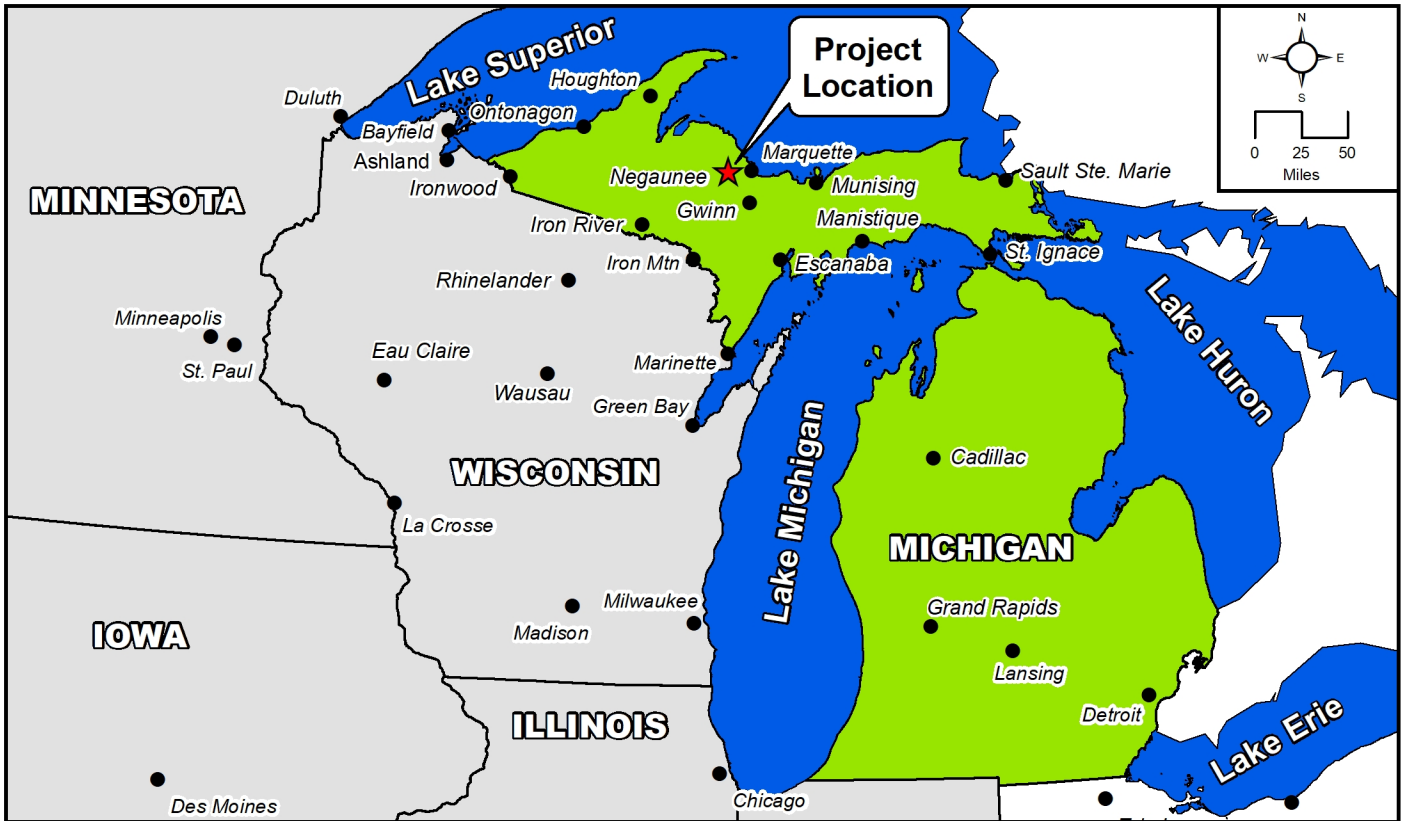
Garth C. Stengard, P.E.
Geotechnical Engineer
Registration Number: 6201050531



APPENDIX A

LOCATION MAPS

- Project Location Map
- Soil Boring Location Map



PROJECT LOCATION MAP




Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

SITE LOCATION MAP



Power Systems Engineering, Inc.
 Proposed Irontown Substation
 Negaunee, MI

Project No:	GIS File:
220452	WIW_WIQ.mxd
Map Date:	Figure No:
8/23/22	Fig 1

B-#
 - APPROXIMATE SOIL BORING LOCATION

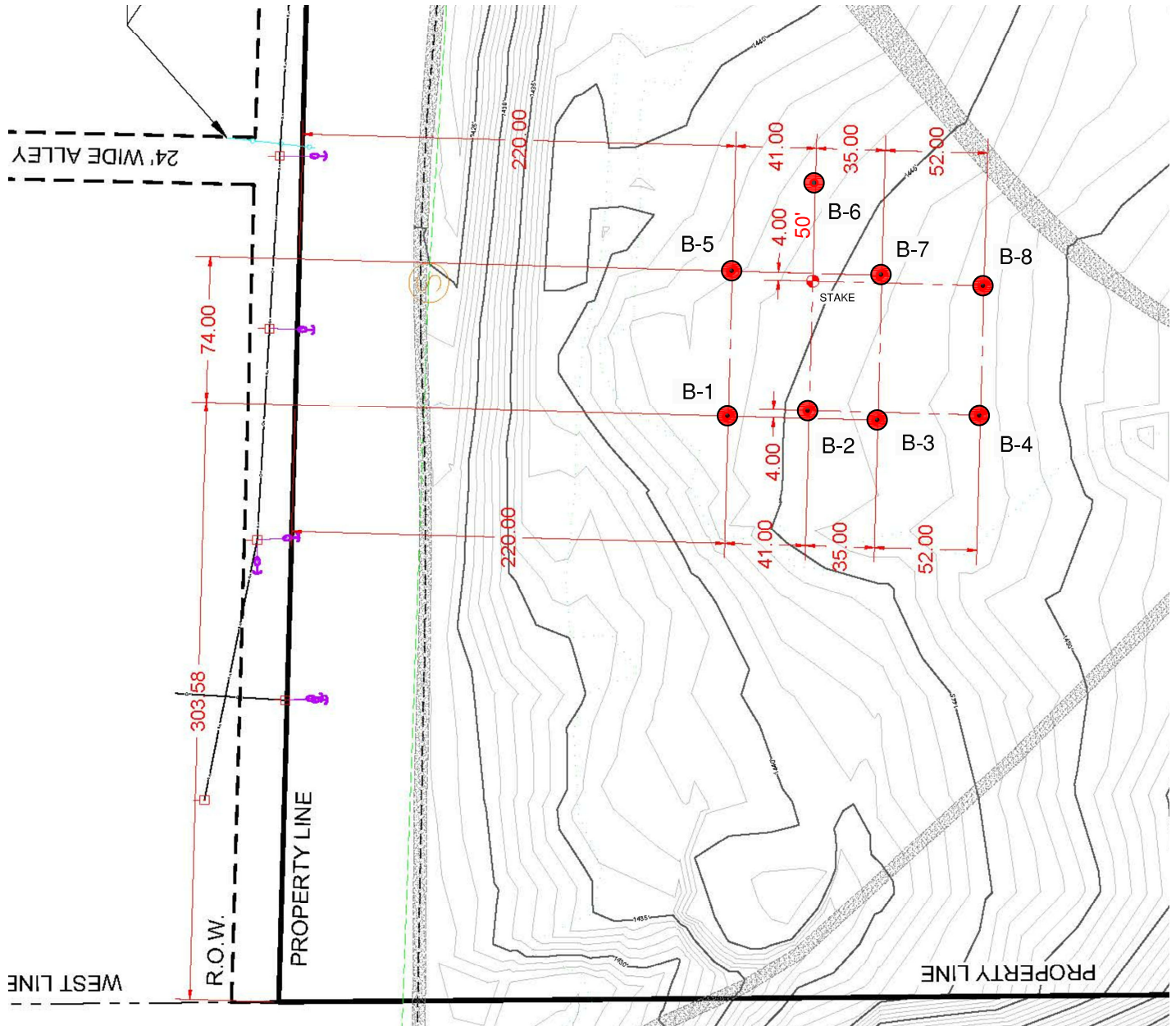
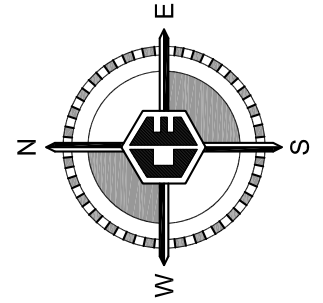
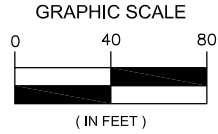
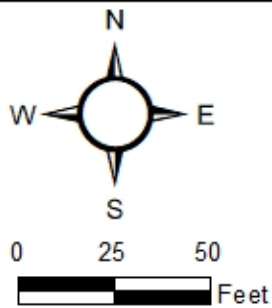



IMAGE FILE PROVIDED BY CLIENT

SOIL BORING LOCATION MAP
POWER SYSTEMS ENGINEERING INC.
PROPOSED IRONTOWN SUBSTATION
NEGAUNEE, MI



Legend

 Approx. Soil Boring

OLD RAILROAD GRADE / SNOWMOBILE TRAIL

SB-1

SB-5

SB-6

SB-2

SB-3

SB-7

SB-4

SB-8

Source: Esri, Mapbox, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

SOIL BORING LOCATION MAP



Power Systems Engineering, Inc.
Proposed Irontown Substation
Negaunee, MI

Project No:	GIS File:
220452	BORELOC.mxd
Map Date:	Figure No:
9/1/22	Fig 2

APPENDIX B

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (UNIFIED SOIL CLASSIFICATION SYSTEM)

COLEMAN ENGINEERING COMPANY

635 Circle Drive
Iron Mountain, Michigan 49801

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES
ASTM Designation: D-2487 – 83
(Based on Unified Soil Classification System)

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $1 > Cc > 3$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines more than 12 % fines ^C	Fines classify as ML or MH Fines classify as CL or CH	GM GC	Silty gravel ^{F,G,H} Clayey gravel ^{F,G,H}	
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand	
			$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines More than 12 % fines ^D	Fines classify as ML or MH Fines classify as CL or CH	SM SC	Silty sand ^{G,H,I} Clayey sand ^{G,H,I}	
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Sils and Clays Liquid limit less than 50	inorganic	$Pl > 7$ and plots on or above "A" line ^J $Pl < 4$ or plots below "A" line ^J	CL ML	Lean clay ^{K,L,M} Silt ^{K,L,M}	
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OL	Organic clay ^{K,L,M,N} Organic silt ^{K,L,M,O}	
	Sils and Clays Liquid limit 50 or more	inorganic	Pl plots on or above "A" line Pl plots below "A" line	CH MH	Fat clay ^{K,L,M} Elastic silt ^{K,L,M}	
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OH	Organic clay ^{K,L,M,P} Organic silt ^{K,L,M,Q}	
	Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

^A Based on the material passing the 3-in. (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

^D Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

$$^E C_u = D_{60}/D_{10} \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soils contains ≥ 15 % sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains ≥ 15 % gravel, add "with gravel" to group name.

^J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel", whichever is predominant.

^L If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.

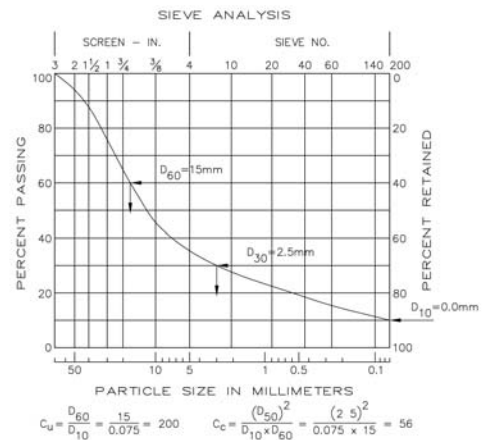
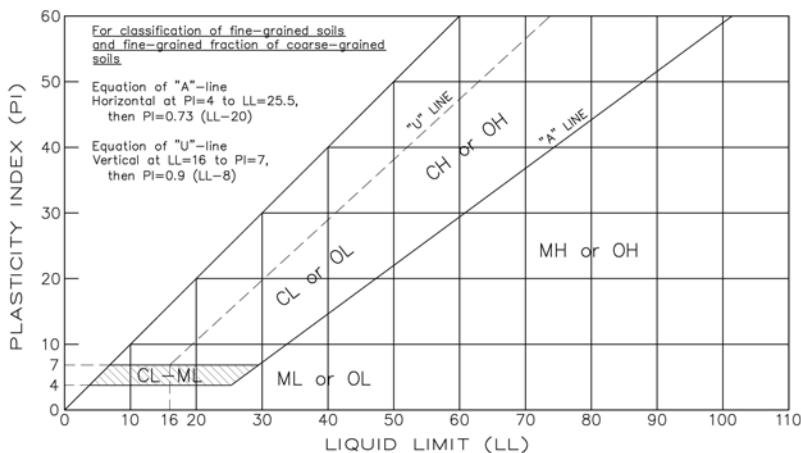
^M If soil contains ≥ 30 % plus No. 200, predominately gravel, add "gravelly" to group name.

^N $Pl \geq 4$ and plots on or above "A" line.

^O $Pl < 4$ or plots below "A" line.

^P Pl plots on or above "A" line.

^Q Pl plots below "A" line.



APPENDIX C

SOIL EXPLORATION-GENERAL NOTES AND LEGEND

SOIL EXPLORATION GENERAL NOTES AND LEGEND



COLEMAN ENGINEERING COMPANY
635 CIRCLE DRIVE - IRON MOUNTAIN, MICHIGAN 49801 (906) 774-3440
200 EAST AYER STREET - IRONWOOD, MICHIGAN 49938 (906) 932-5048

DESCRIPTIVE SOIL CLASSIFICATION ASTM D2487 / 2488

GRAINSIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	3/4" to 3"	3/4" to 3"
Fine	4.75mm to 3/4"	#4 to 3/4"
Sand: Coarse	2.00mm to 4.75mm	#10 to #4
Medium	0.42mm to 2.00mm	#40 to #10
Fine	0.075mm to 0.42mm	#200 to #40
Silt	0.005mm to 0.075mm	Smaller than #200
Clay	Smaller than 0.005mm	Smaller than #200

GENERAL TERMINOLOGY

Physical Characteristics
Color, moisture, grain shape, fineness, etc.

Major Constituents
Clay, silt, sand, gravel

Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.

Geologic Origin
Glacial, alluvial, eolian, residual, etc.

RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4 BPF
Loose	5-10 BPF
Medium Dense	11-30 BPF
Dense	31-50 BPF
Very Dense	Over 50 BPF

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Proportional Terms	Defining Range By Percentages of Weight
Trace	0%-5%
With	5%-12%
-Y (ie. silty, sandy)	12%-50%

CONSISTENCY

Term	"N"-value	qa (tsf)
Very Soft	0-1 BPF	0.0 to 0.25
Soft	1-4 BPF	0.25 to 0.50
Medium	5-8 BPF	0.50 to 1.0
Stiff	8-16 BPF	1.0 to 2.0
Very Stiff	17-31 BPF	2.0 to 4.0
Hard	Over 32 BPF	Over 4.0

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	Loss on Ignition
Non-Organic	Less than 4%
Organic Silt / Clay	4% - 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

The penetration resistance, N-value, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler or blows per foot (BPF). The sampler is typically driven 18" with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test. When driven 24" the "N" is the sum of the blow of the second and third 6" increment.

SYMBOLS DRILLING AND SAMPLING

RB -	Roller Bit
RC -	Rock Coring
RQD -	Rock Quality Designator
CW -	Clear Water
DM -	Drilling Mud
HSA -	Hollow Stem Auger
SSA -	Solid Stem Auger
HA -	Hand Auger
SPT -	Standard Penetration Test
2SS -	2" Diameter Split-Barrel Sample
3SS -	3" Diameter Split-Barrel Sample
2ST -	2" Diameter Shelby Tube Sample
3ST -	3" Diameter Shelby Tube Sample
PS -	3" Diameter Piston Tube Sample
AS -	Auger Sample
WS -	Wash Sample
NR -	No Recovery
VS -	Vane Shear Test
T -	Torvane Shear Test
BS -	Bag Sample
GS -	Grab Sample
q _a -	Penetrometer Reading, tsf
q _u -	Unconfined Strength, tsf
WOH -	Weight Of Hammer
WOR -	Weight Of Rods

LABORATORY TEST

W -	Moisture Content, %
LL -	Liquid Limit, %
PL -	Plastic Limit, %
SL -	Shrinkage Limit, %
LI -	Loss on Ignition, %
DD -	Dry Density, psf

WATER LEVEL MEASUREMENT

∇	Water Level During Drilling
∇	Water Level After Drilling
∇	Water Level at Time Shown 1
∇	Water Level at Time Shown 2
∇	Water Level at Time Shown 3
∇	Water Level at Time Shown 4
NW -	No Water Encountered
BCR -	Before Casing Removal
ACR -	After Casing Removal

NOTE: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

ROCK CLASSIFICATION

GRAIN SIZE CLASSIFICATION

Grain Size Classes & Siliciclastic Rock Types

256 mm	10 in	Boulders	CONGLOMERATES (rounded class)
64	2.5 in	Cobbles	BRECCIAs (angular class)
4		Pebbles	
2 mm		Granules	
1		V. Coarse	
500 um		Coarse SAND	SANDSTONE
250		Medium	
125		Fine	
63 microns		V. Fine	
32		V. Coarse	
16		Coarse SILT / SILTSTONE	MUDROCKs other types: mudstone shale, marl, slate
8		Medium Silt	
4 microns		Fine Silt	
		CLAY / CLAYSTONE	

Crystalline Rocks

2 mm	Very Coarse Grained
1.0	Coarse Grained
0.5	Medium Grained
0.25	Finely Grained
0.125	Very Finely Grained
0.063	Microcrystalline
0.004	Cryptocrystalline

STRENGTH INDEX

Strength	Description	Approximate Range of Uniaxial Compressive Strength	
		(psi)	(MPa)
Extremely Weak Rock	Can be indented by thumbnail	35 – 150	0.25 – 1.0
Very Weak Rock	Can be peeled by pocket knife	150 – 725	1.0 – 5.0
Weak Rock	Can be peeled with difficulty by pocket knife	725 – 3,500	5.0 – 25
Medium Strong Rock	Can be indented 3/16 inch with sharp end of pick	3,500 – 7,000	25 – 49
Strong Rock	Requires one blow of geologist's hammer to fracture	7,000 – 15,000	49 – 100
Very Strong Rock	Requires many blows of geologist's hammer to fracture	15,000 – 36,000	100 – 250
Extremely Strong Rock	Can only be chipped with blows by geologist's hammer	> 36,000	> 250

WEATHERING INDEX

Term	Description	Grade
Fresh	Rock shows no sign of weathering, loss of strength, or other effects of weathering, such as slight discoloration on major discontinuity surfaces.	I
Slightly Weathered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock.	II
Moderately Weathered	Rock is discolored and noticeably weakened, but less than half is decomposed; a minimum of 2-inch diameter sample can be broken readily by hand across the rock fabric.	III
Highly Weathered	More than half of the rock is decomposed; rock is weathered so that a minimum 2-inch diameter sample can be broken readily by hand across the rock fabric.	IV
Completely Weathered	Original minerals or rock have been almost entirely decomposed to secondary minerals even though the original fabric may be intact; material can be granulated by hand.	V
Residual Soil	Original minerals of rock have been entirely decomposed to secondary minerals, and original rock fabric is not apparent; material can be easily broke by hand.	VI

FRACTURE SPACING

Fracturing	Size Range of Pieces	Remarks
Crushed	Less than 0.1 ft.	Contains Clay
Intensely Fractured	1/16 in. – 0.1 ft.	Contains No Clay
Closely Fractured	0.1 ft. – 0.5 ft.	
Moderately Fractured	0.5 ft. – 1.0 ft.	
Little Fractured	1.0 ft. – 3.0 ft.	
Massive	3.0 ft. and larger	

SEDIMENTARY ROCK BEDDING

Bedding Term	Description
Very Thick-Bedded	Greater than 4 ft. (> 1.2 m)
Thick-Bedded	1 ft. to 4 ft. (0.3 m to 1.2 m)
Medium-Bedded	4 in. to 12 in. (100 mm to 300 mm)
Thin-Bedded	1.2 in. to 4 in. (30 mm to 100 mm)
Very Thin-Bedded	0.5 in. to 1.2 in. (13 mm to 30 mm)
Thickly Laminated	0.1 in. to 0.5 in. (3 mm to 13 mm)
Thinly Laminated	Less than 0.1 in. (< 3 mm)

ROCK QUALITY DESIGNATION (RQD) AND ROCK QUALITY

RQD (%)	Rock Quality
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

APPENDIX D

BORING LOGS



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-1
 CLIENT: Power Systems Engineering, Inc. 1 OF 2
 BORING LOCATION: As-marked by GPS 46.494121450224° N., -87.612411561386° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger, 3-7/8" Roller Bit & NQ Rock Core BORING DEPTH: 23.0
 DATE STARTED: 8/25/22 DATE COMPLETED: 8/26/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Neat Cement 23.0' to 10.0' & Soil Cuttings 10.0' to 0.0'

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS									
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	q _u (tsf)				
1	3-4-5 (9)	1.0		0	TOPSOIL			4-1/4" Hollow Stem Auger 0.0' to 5.0'										
				1	(SP) POORLY GRADED SAND, reddish brown, fine to medium, with gravel, trace roots, moist, loose			2" SPT Sampling 140# wt., 30" drop Auto Hammer 5" casing 0.0' to 5.0'										
2	8-21-27 (48)	0.8		3	...with fractured rock, dense													
				4	(Glacial Till) ± 4.5'			Driller's note: Cobbles and / or boulders 4.0' to 9.0'										
3	10-15-15 (30)	1.5		5	(SP-SM) POORLY GRADED SAND, red, fine to medium, with fractured rock, trace gravel, moist, dense			3-7/8" Roller Bit with Quickgel drilling mud 5.0' to 15.0'										
				6														
				7														
4	14-15-15 (30)	0.8		8	...no fractured rock, damp													
				9	(Glacial Till) ± 9.5'													
5	17-21-20 (41)	0.8		10	(SC) CLAYEY SAND, red, fine to medium, with gravel, wet, dense			Driller's note: Samples wet 10.0' to 23.0' Hard drilling 10.0' to 15.0'										
				11														
				12	(Glacial Till) ± 12.5'													
				13	(CL) LEAN CLAY, red, with gravel, wet, hard													
6	39-50/0.1' (-)	0.3		14	(Glacial Till) 14.2'			Sampler bouncing Driller's note: Cobbles and / or boulders 14.0' to 15.0'										
				15	POSSIBLE BOULDER, highly to completely weathered rock, brownish red, with clay													
7	Run 1	0.8		15				NQ Rock Core 15.0' to 23.0' Run 1: 15.0' to 20.0' Drill: 5.0' Recovery: 0.8'										
				16														
				17														
				18														
				19														
				20														

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2ST-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling

after hours

BORING NO.:
SB-1



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-1

CLIENT: Power Systems Engineering, Inc. 2 OF 2

BORING LOCATION: As-marked by GPS 46.494121450224° N., -87.612411561386° W. See soil boring loc. dwg. ELEV.: Same as ex. str.

RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes

DRILLING METHOD: 4-1/4" Hollow Stem Auger, 3-7/8" Roller Bit & NQ Rock Core BORING DEPTH: 23.0

DATE STARTED: 8/25/22 DATE COMPLETED: 8/26/22 REVIEWED BY: J. Kacynski DATE: 9/8/22

HOLE CLOSURE: Neat Cement 23.0' to 10.0' & Soil Cuttings 10.0' to 0.0'

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS									
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf)	q _u (tsf)				
8	50/0.2'	0.2	<input checked="" type="checkbox"/>	20	POSSIBLE BOULDER			Run 2: 20.2' to 23.0'										
9	Run 2	0.7	<input checked="" type="checkbox"/>	21	BEDROCK, Iron Formation, dark gray with red oxidation and tan chert banding, fine grained, medium strong rock, slightly to moderately weathered, with moderately to highly weathered joints, closely fractured to crushed, clay present			Drill: 2.8'										
				22				Recovery: 0.7'										
				23	End of Boring			RQD: 0%										
				24				RMR: 13										
				25														
				26														
				27														
				28														
				29														
				30														
				31														
				32														
				33														
				34														
				35														
				36														
				37														
				38														
				39														
				40														

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling

after hours

BORING NO.:
SB-1



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-2
 CLIENT: Power Systems Engineering, Inc. 1 OF 1
 BORING LOCATION: As-marked by GPS 46.49399729710° N., -87.612445309740° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger BORING DEPTH: 16.5
 DATE STARTED: 8/22/22 DATE COMPLETED: 8/22/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	
1	3-5-8 (13)	0.8	0	TOPSOIL 0.3'			4-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
2	9-16-11 (27)	1.5	1	(SP) POORLY GRADED SAND, reddish brown, fine to medium, with gravel, trace roots, moist, medium dense ...no roots			Driller's note: Cobbles and / or boulders 3.0' to 4.0'							
3	7-11-15 (26)	1.3	2											
			3											
			4											
4	11-16-15 (31)	1.4	5	(Glacial Till) ± 7.0'			Driller's note: Cobbles and / or boulders 6.0' to 15.5'							
			6	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with silt and gravel, moist, dense										
			7											
			8											
5	7-17-15 (32)	1.4	9											
			10											
			11											
			12				Driller's note: Hard drilling 12.0' to 15.0'							
			13											
			14	(Glacial Till) ± 13.5'										
			15	(CL) LEAN CLAY, reddish brown, with gravel and moderately weathered rock, moist, hard										
6	4-16-15 (31)	1.5	16											
			17	(Glacial Till) 16.5'										
			18	End of Boring										
			19											
			20											

-AS-Auger Sample -MC-Macrocore -3SS-3" Split Spoon while drilling
 -BS-Bag Sample -PS-Piston Tube -2ST-2" Shelby Tube after drilling 15.5
 -RC-Rock-Core -2SS-2" Split Spoon -3ST-3" Shelby Tube

BORING NO.: **SB-2**



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-3
 CLIENT: Power Systems Engineering, Inc. 1 OF 1
 BORING LOCATION: As-marked by GPS 46.493888794093° N., -87.612446407593° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger BORING DEPTH: 17.1
 DATE STARTED: 8/22/22 DATE COMPLETED: 8/23/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Soil Cuttings

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4 -200	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf)	q _u (tsf)	
1	3-5-3 (8)	1.5		0	TOPSOIL 0.3'			4-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
				1	(FILL) POORLY GRADED SAND, brown, fine to medium, with gravel and crushed asphalt, moist										
2	9-13-17 (30)	1.5		2	(SP) POORLY GRADED SAND, brown, fine to medium, with gravel, moist, dense ± 2.0'			Driller's note: Wire in cuttings at ± 2.0'							
				3											
				4				Driller's note: Cobbles and / or boulders 4.0' to 9.0'							
3	11-16-17 (33)	1.1		5	...trace clay			3" split spoon used for sample #3 recovery							
				6											
				7											
4	12-16-25 (41)	0.5		8	...no clay										
				9											
				10	(Glacial Till) ± 9.5' (CL) LEAN CLAY, reddish brown, with gravel and fractured rock, damp, hard			Driller's note: Hard drilling 10.0' to 17.1'							
				11											
				12											
				13											
				14											
6	6-11-9 (20)	1.5		15	...very stiff										
				16											
				17	(Glacial Till) ± 16.7' (POSSIBLE BEDROCK) FRACTURED AND WEATHERED ROCK, reddish brown, wet 17.1'			Sampler bouncing							
7	50/0.1' (-)	0.1		18	End of Boring										
				19											
				20											

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling 17.0

after hours

BORING NO.:
SB-3



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-4
 CLIENT: Power Systems Engineering, Inc. 1 OF 1
 BORING LOCATION: As-marked by GPS 46.493759165278° N., -87.612434507395° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger BORING DEPTH: 18.7
 DATE STARTED: 8/24/22 DATE COMPLETED: 8/24/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Soil Cuttings

NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND	DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS					
									+4 -200	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf) q _u (tsf)	
1	3-3-3 (6)	1.0		0	TOPSOIL 0.3'			4-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer						
				1	(SP) POORLY GRADED SAND, reddish brown, fine to medium, with roots, trace gravel, moist, loose									
2	3-3-16 (19)	1.1		2	...no roots, with gravel, medium dense									
				3										
				4	(Glacial Till) ± 4.5'									
3	8-10-10 (20)	1.5		5	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with silt and gravel, moist, medium dense									
				6										
				7	(Glacial Till) ± 7.0'									
4	4-6-11 (17)	1.3		8	(SM) SILTY SAND, reddish brown, fine to medium, with gravel, wet, medium dense			Driller's note: Samples wet 7.5' to 9.0' Driller's note: Cobbles and / or boulders 8.0' to 18.6'						
				9										
				10	(Glacial Till) ± 9.5'									
5	27-31-34 (65)	0.4		11	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with silt and gravel, moist, very dense			Pushed a rock / rock in tip of sampler. 3" split spoon used for sample #5 recovery						
				12										
				13				Driller's note: Hard drilling 12.5' to 18.0'						
				14	(Glacial Till) ± 13.5'									
				15	(POSSIBLE BEDROCK) FRACTURED AND WEATHERED ROCK, reddish brown, with clay, crushed, damp									
6	22-29-33 (62)	1.1		16										
				17										
				18										
7	39-50/0.1' (-)	0.6		18	(Glacial Till) 18.7'									
				19	End of Boring			Sampler bouncing						
				20										

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling 16.0

after hours

BORING NO.:
SB-4



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-5

CLIENT: Power Systems Engineering, Inc. 1 OF 1

BORING LOCATION: As-marked by GPS 46.494129955562° N., -87.612167394034° W. See soil boring loc. dwg. ELEV.: Same as ex. str.

RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes

DRILLING METHOD: 4-1/4" Hollow Stem Auger BORING DEPTH: 12.9

DATE STARTED: 8/23/22 DATE COMPLETED: 8/24/22 REVIEWED BY: J. Kacynski DATE: 9/8/22

SOLE CLOSURE: Soil Cuttings

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4 -200	MOISTURE CONTENT (%)	LL PL	T (tsf)	q _a (tsf)	q _u (tsf)	
1	3-3-5 (8)	1.0		0	TOPSOIL 0.3'			4-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
				1	(SP) POORLY GRADED SAND, brown, fine to medium, with gravel and roots, moist, loose										
2	9-13-18 (31)	1.1		2	...trace roots, dense										
				3											
				4	(Glacial Till) ± 4.5'										
3	8-12-14 (26)	1.5		5	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with silt and gravel, moist, medium dense			Driller's note: Cobbles and / or boulders 5.0' to 8.0'							
				6											
				7	(Glacial Till) ± 7.0'										
4	6-10-12 (22)	1.5		8	(SC) CLAYEY SAND, reddish brown, fine to medium, with gravel, moist, medium dense										
				9											
				10	(Glacial Till) ± 9.5'			Driller's note: Hard drilling 9.0' to 12.0'							
5	11-27-28 (55)	1.3		11	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with gravel and fractured rock, moist, very dense										
				12											
6	37-50/0.3' (-)	NR		13	(Glacial Till) 12.9' End of Boring	▼		Sampler bouncing							
				14											
				15											
				16											
				17											
				18											
				19											
				20											

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube

▼ while drilling
 ▼ after drilling 12.0

▼ after hours

BORING NO.:
SB-5



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-6
 CLIENT: Power Systems Engineering, Inc. 1 OF 1
 BORING LOCATION: As-marked by GPS 46.494022527436° N., -87.611989231575° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / M. Sovey / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger & 3-7/8" Roller Bit BORING DEPTH: 14.0
 DATE STARTED: 8/19/22 DATE COMPLETED: 8/19/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Bentonite Chips 14.0' to 5.0' & Soil Cuttings 5.0' to 0.0'

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS					
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	q _u (tsf)
1	3-3-14 (17)	0.8		0	TOPSOIL 0.3'			4-1/4" Hollow Stem Auger 0.0' to 5.0' 2" SPT Sampling 140# wt., 30" drop Auto Hammer						
				1	(SP) POORLY GRADED SAND, brown, fine to medium, with gravel, trace roots, moist, medium dense									
				2	(Glacial Till) ± 2.0'									
2	5-9-8 (17)	1.5		3	(SP-SM) POORLY GRADED SAND, red, fine to medium, with silt and gravel, moist, medium dense									
				4	(Glacial Till) ± 4.5'									
3	11-16-22 (38)	1.5		5	(SC) CLAYEY SAND, red, fine to medium, with fractured rock, moist, dense			3-7/8" Roller Bit with Quickgel drilling mud 5.0' to 14.0' Driller's note: Cobbles and / or boulders 5.5' to 8.0' Hard drilling 5.5' to 14.0'						
				6										
				7										
4	10-14-13 (27)	1.1		8	...damp, medium dense									
				9	(Glacial Till) ± 9.5'									
5	14-9-13 (22)	1.2		10	(CL) LEAN CLAY, red, with gravel, damp, very stiff									
				11										
				12										
				13				Driller's note: Cobbles and / or boulders 12.5' to 14.0'						
6	50/0.2' (-)	NR		14	(Glacial Till) 14.0' End of Boring			Driller's note: Possible weathered bedrock						
				15										
				16										
				17										
				18										
				19										
				20										

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling

after hours

BORING NO.:
SB-6



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-7

CLIENT: Power Systems Engineering, Inc. 1 OF 1

BORING LOCATION: As-marked by GPS 46.493882554563° N., -87.612205218646° W. See soil boring loc. dwg. ELEV.: Same as ex. str.

RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / C. Evosevich-Hynes

DRILLING METHOD: 4-1/4" Hollow Stem Auger BORING DEPTH: 18.3

DATE STARTED: 8/23/22 DATE COMPLETED: 8/23/22 REVIEWED BY: J. Kacynski DATE: 9/8/22

SOLE CLOSURE: Soil Cuttings

NUMBER	SAMPLE		DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS						
	SPT VALUES BLOWS/6"(N)	RECOVERY						LEGEND	+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	
1	3-4-4 (8)	1.2	0	TOPSOIL 0.2'			4-1/4" Hollow Stem Auger 2" SPT Sampling 140# wt., 30" drop Auto Hammer							
			1	(FILL) POORLY GRADED SAND, brown, fine to medium, with crushed asphalt, trace roots and clay, moist, loose										
			2	± 2.0'										
2	20-26-34 (60)	1.3	3	(SP) POORLY GRADED SAND, reddish brown, fine to medium, with gravel and fractured rock, moist, very dense			Driller's note: Cobbles and / or boulders 2.5' to 6.5'							
			4	(Glacial Till) ± 4.5'										
3	18-23-18 (41)	1.3	5	FRACTURED ROCK, gray, with reddish brown silty sand, moist, dense										
			6											
			7	(Glacial Till) ± 7.0'										
4	4-10-12 (22)	1.1	8	(SP-SM) POORLY GRADED SAND, reddish brown, fine to medium, with silt and fractured rock, moist, medium dense										
			9				Driller's note: Hard drilling 9.0' to 17.0'							
5	8-14-18 (32)	1.5	10	...dense										
			11											
			12											
			13	(Glacial Till) ± 13.5'										
			14	(CL) LEAN CLAY, reddish brown, with gravel and fractured rock, damp, very stiff			Driller's note: Cobbles and / or boulders 14.0' to 17.0'							
6	7-9-7 (16)	1.3	15											
			16											
			17	(Glacial Till) ± 16.7'										
7	21-19-50/0.3' (-)	0.2	17	(POSSIBLE BEDROCK) FRACTURED AND WEATHERED ROCK, reddish gray, fine to coarse, crushed, moist										
			18											
			18.3'				Sampler bouncing							
			19	End of Boring										
			20											

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling

after hours

BORING NO.:
SB-7



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-8
 CLIENT: Power Systems Engineering, Inc. 1 OF 2
 BORING LOCATION: As-marked by GPS 46.493780096203° N., -87.612178793886° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / M. Sovey / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger, 3-7/8" Roller Bit & NQ Rock Core BORING DEPTH: 35.8
 DATE STARTED: 8/26/22 DATE COMPLETED: 8/29/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Neat Cement 35.8' to 18.0', Bentonite Chips 18.0' to 5.0' & Soil Cuttings 5.0' to 0.0'

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS					
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	q _u (tsf)
1	2-5-5 (10)	0.8		0	TOPSOIL 0.1'			4-1/4" Hollow Stem Auger 0.0' to 5.0' 2" SPT Sampling 140# wt., 30" drop Auto Hammer 5" casing 0.0' to 5.0'						
				1	(FILL) POORLY GRADED SAND, brownish red, fine to medium, with gravel and fractured rock, some clay lumps, moist									
2	6-14-25 (39)	0.8		2	(SP-SM) POORLY GRADED SAND, brownish red, fine to coarse, with silt and gravel and fractured rock, moist, dense ± 2.0'									
				3										
				4				Driller's note: Cobbles and / or boulders 4.0' to 6.5'						
3	17-41-23 (64)	0.9		5	...some gray, with large fractured rock, very dense			3-7/8" Roller Bit with Quickgel drilling mud 5.0' to 28.6'						
				6										
				7	(Glacial Till) ± 7.0'									
4	9-8-14 (22)	0.7		8	(SM) SILTY SAND, reddish brown, fine, with dark gray fractured rock, some clay, damp, medium dense									
				9										
5	10-10-11 (21)	0.9		10	...no fractured rock, wet			Driller's note: Samples wet 10.0' to 25.0'						
				11										
				12										
				13				Driller's note: Cobbles and / or boulders 12.5' to 13.0'						
6	9-8-6 (14)	0.8		14										
				15										
				16										
				17	(POSSIBLE BEDROCK) WEATHERED AND FRACTURED ROCK, brownish red, clayey, with silt, wet ± 17.0'			Driller's note: Hard drilling 17.0' to 28.5'						
				18										
7	50/0.4' (-)	0.3		19										
				20										

- AS-Auger Sample
- BS-Bag Sample
- RC-Rock-Core
- MC-Macrocore
- PS-Piston Tube
- 2SS-2" Split Spoon
- 3SS-3" Split Spoon
- 2ST-2" Shelby Tube
- 3ST-3" Shelby Tube
- while drilling
- after drilling

after hours

BORING NO.:
SB-8



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE
 IRON MOUNTAIN, MICHIGAN 49801
 Telephone: (906)-774-3440 Fax: (906)-774-7776

JOB NO.: 220452.GPJ

PROJECT: Proposed Irontown Substation BORING NO.: SB-8
 CLIENT: Power Systems Engineering, Inc. 2 OF 2
 BORING LOCATION: As-marked by GPS 46.493780096203° N., -87.612178793886° W. See soil boring loc. dwg. ELEV.: Same as ex. str.
 RIG TYPE: Diedrich D-50 ATV DRILL CREW: D. Ebidon / M. Sovey / C. Evosevich-Hynes
 DRILLING METHOD: 4-1/4" Hollow Stem Auger, 3-7/8" Roller Bit & NQ Rock Core BORING DEPTH: 35.8
 DATE STARTED: 8/26/22 DATE COMPLETED: 8/29/22 REVIEWED BY: J. Kacynski DATE: 9/8/22
 HOLE CLOSURE: Neat Cement 35.8' to 18.0', Bentonite Chips 18.0' to 5.0' & Soil Cuttings 5.0' to 0.0'

SAMPLE				DEPTH (FT)	SOIL DESCRIPTION	WATER TABLE	ELEV. (FT)	COMMENTS	TEST RESULTS										
NUMBER	SPT VALUES BLOWS/6"(N)	RECOVERY	LEGEND						+4	MOISTURE CONTENT (%)	LL	T (tsf)	q _a (tsf)	q _u (tsf)					
8	50/0.3' (-)	0.3		20	(POSSIBLE BEDROCK) WEATHERED AND FRACTURED ROCK, brownish red, clayey, with silt, wet														
9	50/0.1'	NR		28.6'															
10	Run 1	2.0		29	BEDROCK, Iron Formation, dark gray with red oxidation and tan chert banding, fine grained, weak to strong rock, slightly to moderately weathered, with moderately to highly weathered joints, closely fractured to crushed, clay present			Sampler Bouncing NQ Rock Core 28.6' to 35.8' Run 1: 28.6' to 30.6' Drill: 2.0' Recovery: 2.0' RQD: 18% RMR: 18											
11	Run 2	4.3		31	...clay infilling from 30.6' to 31.0'			Run 2 and 3: 30.6' to 35.8' Drill: 5.2' Recovery: 4.5' RQD: 0% RMR: 15											
12	Run 3	0.2		35.8'	End of Boring														

- AS-Auger Sample
- MC-Macrocore
- 3SS-3" Split Spoon
- while drilling
- BS-Bag Sample
- PS-Piston Tube
- 2ST-2" Shelby Tube
- after drilling
- RC-Rock-Core
- 2SS-2" Split Spoon
- 3ST-3" Shelby Tube

BORING NO.:
SB-8

APPENDIX E

TABLES

Table 1: Design Parameters

Table 2: Drilled Pier Unit Resistance Values



Table 1: Design Parameters
Proposed Irontown Substation
Negaunee, Michigan

Boring #	As-Drilled Lat / Long Coordinates	Depth Range (ft)	Predominant Soil Type	Geological Description	Index Properties %			Estimated Depth to Ground Water (ft)	Total Unit Weight (pcf) ^a	Standard Blow Count (N/N ₆₀)		Pressure-meter modulus (ksi) ^b	Undrained Parameter		Drained Parameter		Soil Modulus Parameter k		Soil Strain E50/ *k _{rm}	Strength Reduction Factors ^d
					LL	PL	W			N	N ₆₀		Cu (ksf)	Φ (°)	c' (ksf)	Φ' (°)	Static (pci)	Cyclic (pci)		
SB-1	46.494121450224 -87.612411561386	0-4.5	(SP) Poorly Graded Sand	Glacial Till	-	-	M	10.0	120	48	50+	4.8	0	38	0	38	225	-	-	0.94
		4.5-12.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M/W	10.0	120	34	44	3.2	0	37	0	37	125	-	-	0.96
		12.5-14.2	(CL) Lean Clay	Glacial Till	-	-	W	10.0	130	50+	50+	4.0	4.0	0	0	30	2000	400	0.004	0.40
		14.2-20.2	Possible Boulder	Glacial Till	-	-	-	10.0	130	50+	50+	5.0	0	38	0	38	125	-	-	0.94
		20.2-23	Bedrock	Iron Formation	-	-	-	10.0	160	RQD: 0	RMR: 13	-	80 ^C	-	80 ^C	-	-	-	-	0.00001*
SB-2	46.493999729710 -87.612445309740	0-13.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	15.5	120	28	36	2.6	0	36	0	36	90	-	-	0.98
		13.5-16.5	(CL) Lean Clay	Glacial Till	-	-	M/W	15.5	130	31	40	2.5	4.0	0	0	30	2000	800	0.004	0.40
SB-3	46.493888794093 -87.612446407593	0-2	(Fill) Poorly Graded Sand	Fill	-	-	M	17.0	105	8	10	0.8	0	30	0	30	25	-	-	1.0
		2-9.5	(SP) Poorly Graded Sand	Glacial Till	-	-	M	17.0	120	35	45	3.5	0	38	0	38	225	-	-	0.94
		9.5-16.7	(CL) Lean Clay	Glacial Till	-	-	M	17.0	130	27	35	2.2	4.0	0	0	30	2000	800	0.004	0.40
		16.7-17.1	Fractured and Weathered Bedrock	Glacial Till	-	-	M	17.0	130	50+	50+	5.0	0	38	0	38	225	-	-	0.94
SB-4	46.493759165278 -87.612434507395	0-9.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	16.0	120	19	25	1.7	0	34	0	34	90	-	-	1.0
		9.5-13.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	16.0	120	50+	50+	5.0	0	38	0	38	225	-	-	0.94
		13.5-18.7	Fractured and Weathered Bedrock	Glacial Till	-	-	M/W	16.0	130	50+	50+	5.0	0	38	0	38	125	-	-	0.94
SB-5	46.494129955562 -87.612167394034	0-9.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	12.0	120	26	33	2.5	0	35	0	35	90	-	-	1.0
		9.5-12.9	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	12.0	120	50+	50+	5.0	0	38	0	38	225	-	-	0.94



Table 1: Design Parameters
Proposed Irontown Substation
Negaunee, Michigan

Boring #	As-Drilled Lat / Long Coordinates	Depth Range (ft)	Predominant Soil Type	Geological Description	Index Properties %			Estimated Depth to Ground Water (ft)	Total Unit Weight (pcf) ^a	Standard Blow Count (N/N ₆₀)		Pressure-meter modulus (ksi) ^b	Undrained Parameter		Drained Parameter		Soil Modulus Parameter k		Soil Strain E50/*k _{rm}	Strength Reduction Factors ^d
					LL	PL	W			N	N ₆₀		Cu (ksf)	Φ (°)	c' (ksf)	Φ' (°)	Static (pci)	Cyclic (pci)		
SB-6	46.494022527436 -87.611989231575	0-4.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	NA	115	17	22	1.6	0	33	0	33	90	-	-	1.0
		4.5-9.5	(SC) Clayey Sand	Glacial Till	-	-	M	NA	125	32	41	3.0	0	35	0	35	225	-	-	1.0
		9.5-14	(CL) Lean Clay	Glacial Till	-	-	M	NA	130	22	28	1.7	3.5	0	0	30	1000	400	0.005	0.41
SB-7	46.493882554563 -87.612205218646	0-2	(Fill) Poorly Graded Sand	Fill	-	-	M	NA	105	8	10	0.8	0	30	0	30	25	-	-	1.0
		2-7	(SP) Poorly Graded Sand	Glacial Till	-	-	M	NA	120	50	50+	5.0	0	38	0	38	225	-	-	0.94
		7-13.5	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	NA	120	27	35	2.5	0	35	0	35	90	-	-	1.0
		13.5-16.7	(CL) Lean Clay	Glacial Till	-	-	M	NA	130	16	21	1.3	2.6	0	0	30	1000	400	0.005	0.43
		16.7-18.3	Fractured and Weathered Bedrock	Glacial Till	-	-	M	NA	130	50+	50+	5.0	0	38	0	38	225	-	-	0.94
SB-8	46.493780096203 -87.612178793886	0-2	(Fill) Poorly Graded Sand	Fill	-	-	M	10.0	105	10	13	1.0	0	30	0	30	25	-	-	1.0
		2-7	(SP-SM) Poorly Graded Sand with Silt	Glacial Till	-	-	M	10.0	120	39	50+	3.7	0	38	0	38	225	-	-	0.94
		7-17	(SM) Silty Sand	Glacial Till	-	-	M/W	10.0	120	19	25	1.7	0	33	0	33	60	-	-	1.0
		17-28.6	Fractured and Weathered Bedrock	Glacial Till	-	-	W	10.0	130	50+	50+	5.0	0	38	0	38	125	-	-	0.94
		28.6-35.8	Bedrock	Iron Formation	-	-	-	10.0	160	RQD: 18, 0	RMR: 18, 15	-	80 ^c	-	80 ^c	-	-	-	-	0.00001*

Table 1
^a For effective/submerged unit weight below groundwater level, subtract 62.4 pcf, from the moist unit weight.
^b Indicates Estimated Pressuremeter Modulus.
^c Estimated shear strength
^d Strength reduction factors as defined in EPRI 2197

The above parameters were estimated based on soil types and blow counts.

For Index Properties (W): m – moist, w - wet

The Modulus of Elasticity (E) for gravel backfill is E ~ 200 TSF (2.8 ksi) for loose condition and E ~ 300 TSF (4.2 ksi) for medium to dense condition.

Design parameters do not include a factor of safety.



Table 2: Unit Resistance Values
Proposed Irontown Substation
Negaunee, Michigan

SB-1				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	Poorly Graded Sand	0	4.5	-	-	-
2	Poorly Graded Sand with Silt	4.5	5.0	-	-	-
3	Poorly Graded Sand with Silt	5.0	10.0	0.33	0.19	34
4	Poorly Graded Sand with Silt	10.0	12.5	0.47	0.27	48
5	Lean Clay	12.5	14.2	1.30	1.30	36
6	Possible Boulder	14.2	20.2	0.63	0.36	71
7	Bedrock	20.2	23+	-	-	BR

SB-2				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	Poorly Graded Sand with Silt	0	5.0	-	-	-
2	Poorly Graded Sand with Silt	5.0	10.0	0.32	0.18	27
3	Poorly Graded Sand with Silt	10.0	13.5	0.50	0.29	42
4	Lean Clay	13.5	16.5	1.30	1.30	36
5	Bedrock	16.5+	-	-	-	BR



Table 2: Unit Resistance Values
Proposed Irontown Substation
Negaunee, Michigan

SB-3				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	(Fill) Poorly Graded Sand	0	2.0	-	-	-
2	Poorly Graded Sand	2.0	5.0	-	-	-
3	Poorly Graded Sand	5.0	9.5	0.33	0.19	37
4	Lean Clay	9.5	17.1	1.30	1.30	36
5	Bedrock	17.1+	-	-	-	BR

SB-4				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	Poorly Graded Sand with Silt	0	5.0	-	-	-
2	Poorly Graded Sand with Silt	5.0	9.5	0.29	0.17	18
3	Poorly Graded Sand with Silt	9.5	13.5	0.52	0.30	59
4	Weathered Bedrock	13.5	16.0	0.67	0.38	77
5	Weathered Bedrock	16.0	18.7	0.77	0.44	88
6	Bedrock	18.7+	-	-	-	BR



Table 2: Unit Resistance Values
Proposed Irontown Substation
Negaunee, Michigan

SB-5				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	Poorly Graded Sand with Silt	0	5.0	-	-	-
2	Poorly Graded Sand with Silt	5.0	9.5	0.30	0.17	22
3	Poorly Graded Sand with Silt	9.5	12.9	0.51	0.29	56
4	Bedrock	12.9+	-	-	-	BR

SB-6				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	Poorly Graded Sand with Silt	0	4.5	-	-	-
2	Clayey Sand	4.5	5.0	-	-	-
3	Clayey Sand	5.0	9.5	0.30	0.17	22
4	Lean Clay	9.5	14.0	1.20	1.20	32
5	Bedrock	14+	-	-	-	BR



Table 2: Unit Resistance Values
Proposed Irontown Substation
Negaunee, Michigan

SB-7				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	(Fill) Poorly Graded Sand	0	2.0	-	-	-
2	Poorly Graded Sand	2.0	5.0	-	-	-
3	Poorly Graded Sand	5.0	7.0	0.26	0.15	30
4	Poorly Graded Sand with Silt	7.0	13.5	0.41	0.23	30
5	Lean Clay	13.5	16.7	1.10	1.10	23
6	Weathered Bedrock	16.7	18.3	0.79	0.45	89
7	Bedrock	18.3+	-	-	-	BR

SB-8				Drilled Pier Unit Resistance Values		
Layer	Soil Type	Depth (ft)		Ultimate Skin Friction		Ultimate End Bearing (ksf)
		Top	Bottom	Average Compressive	Average Tension	
1	(Fill) Poorly Graded Sand	0	2.0	-	-	-
2	Poorly Graded Sand with Silt	2.0	5.0	-	-	-
3	Poorly Graded Sand with Silt	5.0	7.0	0.26	0.15	30
4	Silty Sand	7.0	10.0	0.32	0.18	17
5	Silty Sand	10.0	17.0	0.44	0.25	24
6	Weathered Bedrock	17.0	24.0	0.69	0.39	80
7	Weathered Bedrock	24.0	28.6	0.85	0.49	96
8	Bedrock	28.6	35.8+	-	-	BR

Ultimate capacities do not include a Factor of Safety.

Ultimate capacity is recommended to be the lowest value within 2 times the footing width below bearing elevation.

Ultimate skin friction capacity = (unit resistance value) x (side surface area).

Ultimate end bearing capacity = (unit resistance value) x (bottom surface area).

Neglect skin friction in the top 5 feet to account for frost zone and construction disturbance.

Unit resistance values do not account for the weight of pole/pier.

BR (Bedrock) denotes limited to the Structural Capacity of the Pole/Pile.

APPENDIX F

TEST RESULTS AND
PHOTOGRAPHS



COLEMAN ENGINEERING COMPANY

635 CIRCLE DRIVE • IRON MOUNTAIN, MI 49801 • PHONE: 906-774-3440
200 EAST AYER STREET • IRONWOOD, MI 49938 • PHONE: 906-932-5048
120 US HWY 41 EAST, STE B • NEGAUNEE, MI 49866 • PHONE: 906-475-7489

POINT - LOAD STRENGTH INDEX OF ROCK

ASTM D5731

Project: Proposed Irontown Substation
Client: Power Systems Engineering, Inc

Job No.: GL-220452C
Date Rec.: 9/2/2022

Core Number	Depth (ft)	Diameter (mm)	Length (mm)	Load (kN)	Orientation	Strength Index	Estimated Compressive Strength	
							Mpa	psi
SB-1 (2A)	22.7'	47.90	41.32	4.1	AXIAL	1.79	42.9	6,220
							Average	6,220
SB-8 (1A)	29.0	48.32	35.95	6	AXIAL	2.57	61.7	8,945
SB-8 (2A)	32.5	47.95	42.76	2.3	AXIAL	1.00	24.0	3,482
							Average	6,214

Equipment Used: Point Load A125, ORD 3494; Caliper 6" A17063784

Remarks: _____

Tested By: J. Kacynski
Laboratory: Iron Mountain

Date: 9/7/2022

Submitted By: *W. Edlebeck*

Date: 9/08/22



Boring SB-1 Depth 15.0' - 20.0' and 20.2' - 23.0'





Boring SB-8 Depth 28.6' - 35.8'



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DIVISION 5 - STRUCTURAL

SECTION 05 20 00 - STEEL STRUCTURE ERECTION

SECTION INDEX

1. General
 2. Codes and Standards
 3. Materials
 4. Installation of Structures
 5. Repair of Galvanizing
-

1 GENERAL

1.1 Scope

This section applies to the assembly and/or fabrication of steel structures for use in electrical substations. Structural steel, structural and equipment bolts, nuts and washers as specified on the erection drawings to be supplied by others.

1.2 Substation Suppliers

It is the intent that complete substations have been fabricated and supplied by a single manufacturer regularly engaged in the fabrication of substation structures.

2 CODES AND STANDARDS

Work shall be in accordance with applicable codes and standards of the following organizations:

- American Society for Testing and Materials (ASTM)
- American Institute of Steel Construction (AISC)
- American Iron and Steel Institute (AISI)
- National Electrical Manufacturers Association (NEMA)

3 MATERIALS

Steel substation components conform to the following manufacturing standards:

- Structural steel: ASTM A36
- Connection bolts and nuts: ASTM A394 or A307 galvanized
- Steel washers: ASTM A107
- Locknuts: M-F locknuts
- Anchor bolts: ASTM A307, A36
- Galvanizing: ASTM A123, A153 and A385

4 INSTALLATION OF STRUCTURES

4.1 Assemble accurately as shown on erection drawings.

4.2 Follow match marks.

4.3 Handle materials carefully to prevent damage.

4.4 Slings, or other equipment used for picking up members or portions of structures, shall be of such material or protected in such a way as not to cut into corners of members, damage galvanizing, or distort or overstress members when heavy lifts are made. Members or portions of structures shall be raised in such a manner that no dragging against portions of structure already erected shall occur. A reasonable

amount of drifting will be permitted. Re-drilling or other corrections, if required, shall be undertaken as authorized by the Engineer.

- 4.5 When portions of structures are being preassembled on ground before erection, such assembly shall be on surfaces or blocking which will provide support to prevent distortion of structural steel and prevent dirt, mud, or other foreign materials from adhering to steel. All bolts shall be installed in all connections of preassembled portions or structure, and bolts shall be at least finger tight.
- 4.6 Use light drifting necessary to draw holes together. Light drifting is defined as drifting without causing elongation of holes or deformation of steel members of the structure. Drifting to match unfair holes is not allowed. Use twist drills to enlarge holes to make connections.
- 4.7 Draw up bolted connections reasonably tight as work progresses. Tighten bolts after completion of structures. Only wrenches of proper size, which will not deform nuts or cut or flake galvanizing, shall be used. Bolts shall be normally installed so that nuts are on outside or on top of structure members. All members shall be clean at joints before being bolted.
- 4.8 The use of cutting torch or welding will not be permitted.
- 4.9 Install plumb, level and solidly anchored to foundations or supports furnished and installed under this Contract. Introduce temporary bracing required to support erection loads.
- 4.10 Grout under base plates as specified in Section 030100 or as approved by the Engineer.

5 REPAIR OF GALVANIZING

Each hole drilled after galvanizing or any damaged galvanizing shall be re-galvanized by painting with "Galvanox" Type 1 by Carboline-Subox Div., or equal, application in accordance with manufacturer's recommendations.

END OF SECTION

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DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13 01 21 – SUBSTATION BUILDING

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Submittals
 5. Type of Structure
 6. Materials
 7. Shipping
 8. Installation
 9. Miscellaneous
 10. Warranty and Guarantee
-

1 GENERAL

This section covers requirements to furnish, delivery, and install the substation building. The building, complete with all materials, items, and accessories needed for a complete installation including wall and roof panels, flashing, fascia, wind bracing, connecting devices, fasteners, and caulking, shall be provided as shown on the Drawings and/or specified herein.

2 RELATED SECTIONS

- Section 01 10 00 - General Requirements
- Section 03 01 00 - Cast in Place Concrete
- Section 26 05 43 - Structure Excavations and Backfilling

3 CODES AND STANDARDS

3.1 The structure design and manufacture shall, as a minimum, conform to:

- A. ASCE (American Society of Civil Engineers) “Minimum Design Loads for Buildings and Other Structures.”
- B. Metal Building Manufacturer's Association

3.2 The electrical characteristics and mechanical features of items described herein shall meet the requirements specified herein, shall conform to the latest revisions of the Indiana Administrative Code, and shall comply with other applicable local codes and standards:

- A. American National Standards Institute (ANSI)
- B. Institute of Electrical and Electronics Engineers (IEEE)
- C. National Electric Manufacturers Association (NEMA)
- D. National Electrical Safety Code (NESC)
- E. American Society for Testing and Material (ASTM)
- F. American Institute of Steel Construction (AISC)
- G. National Electric Code (NEC)
- H. Metal Building Manufacturers Association (MBMA)
- I. National Fire Protection Association (NFPA)
- J. American Iron and Steel Institute (AISI)
- K. Uniform Building Code (UBC)
- L. Building Officials & Code Administrators (BOCA)

3.3 The equipment shall be designed, fabricated, and tested in accordance with the above applicable standards and this specification. Testing shall include, but not be limited to, 100% functional tests to verify correctness of wiring and operation of individual equipment, megger tests, and applicable NEMA and IEEE standard tests.

3.4 All materials and devices shall be in accordance with applicable requirements of the U. S. Dept. of Labor “Occupational Safety and Health Administration (OSHA) Standards”. Documentation in the form of material safety data sheet(s) (MSDS) for hazardous and/or toxic substances incorporated into or remaining in the equipment or material shall be provided.

4 SUBMITTALS

Refer to Section 01 10 00. Submit shop drawings and/or product information for the following:

- Engineering calculations that are designed and sealed by the building manufacturer, if applicable.
- Building plan and elevation drawings, and framing/fabrication details.
- Foundation plan and details as needed to accommodate the proposed building design.
- Equipment outlines and details.
- Schematic and wiring diagrams including, but not limited to, lighting, HVAC, smoke alarms, receptacles, and any other electrical devices.
- Proposed heating, ventilation, and air conditioning equipment.
- Bill of Materials.

5 TYPE OF STRUCTURE

The substation building shall be all-steel, prefabricated, self-framing type, of the dimensions shown on the drawings. The building shall be designed for loadings equal to its own dead loading plus a live load of 40 pounds per square foot and a wind load of 26 pounds per square foot. In addition, the building ceiling, floor and walls shall be designed to support the ceiling, floor, and wall mounted equipment loads.

The roof shall be a gable type with a 2:12 slope. Ridge and gable ventilation shall be provided to maintain insulation system efficiency.

The building is to be designed per the UBC for the seismic zone for the site location.

The building shall be fabricated and erected in accordance with the standards of the Metal Building Manufacturer's Association, latest edition.

6 MATERIALS

6.1 Exterior wall and roof panels shall be interlocking ribbed panels, fabricated of 24-gauge galvanized steel per ASTM A525, with the galvanized coating conforming to G90.

6.2 Interior wall panels shall be provided, which consist of 22-gauge zinc-coated steel. In addition, insulation sufficient to obtain a R20 rating or greater shall be placed between the interior and exterior panels.

- 6.3 The ceiling panels shall consist of a minimum of 24-gauge, maximum 16-inch-wide interlocking zinc-coated panels. Insulation sufficient to obtain a R49 rating or greater shall be installed above the ceiling.

The light gauge framing members shall be designed and fabricated in accordance with the latest edition of AISI "Specification for the Design of Light Gauge Cold-Formed Steel Structure Members." Members shall be 16 to 12 gauge as standardized by the manufacturer and shall be zinc-coated steel per ASTM A525.

- 6.4 Exterior wall panels shall be factory painted with a finish coat color to be selected by the Owner. The manufacturer shall provide color choice data for the Owners consideration. Interior wall and ceiling panels shall be factory painted with a finish coat of White.
- 6.5 All standard bolts and nuts shall be ASTM A307 electro-galvanized per ASTM A164. All sheet metal screws shall be stainless steel or cadmium plated.
- 6.6 Doors shall comply with Steel Door Institute SDI-100. Exterior doors shall be insulated with a spun mineral wool and be fitted with extruded aluminum weather-stripping with vinyl inserts on the head and jambs. Door weatherproofing shall be completed by 3/4" x 3-1/2" stainless steel thresholds with vinyl inserts. Doors shall have a wire mesh glass window and inside mounted panic push-bar hardware, as shown on the drawings.
- 6.7 Exterior doors shall have bronze full-mortise hinges and mortise cylinder lockset, minimum of three (3) per door. An overhead surface closer with a mechanical lock or hook to securely hold the door open shall be provided. Each exterior door lockset shall be keyed alike and a minimum of eight (8) duplicate keys shall be provided.
- 6.8 Overhead doors must comply with ANSI/DASMA 102 – American National Standard Specifications for Sectional Overhead Type Doors. The overhead doors shall be designed for loadings equal to a wind load of 26 pounds per square foot. Overhead door shall have insulation sufficient to obtain a R15 rating or greater.
- 6.9 An overhead door with an opening height of 9 feet and an opening width of 9 feet shall be provided, as shown on the drawings. Overhead doors shall have electric wall mounted motor operation and be rated for 120/240 V AC single phase power. Overhead doors shall have a keyed lock with interlock switch for an automatic operator. An interior surface mounted push-button and key operated control station with open, close, and stop buttons shall be provided. A minimum of eight (8) duplicate keys shall be provided.
- 6.10 The spring counterbalance shall be sized based on the weight of the overhead door, with a helically wound, oil tempered torsion spring mounted on a steel shaft. Sized with a minimum 7 to 1 safety factor. The building manufacturer and installation Contractor shall each be responsible for providing a track as recommended by manufacturer to suit loading requirements and available clearance as shown on the drawings.
- 6.11 Provisions for a wall-mounted 115 VAC exhaust fan, installed as shown on the drawings, capable of exhausting 600 CFM at 1/8" static pressure with a gravity-operated anti-back

draft exhaust damper, and insulated cover for use during winter. The fan shall have a 7 day/24-hour, 120 AC powered timer to run the fan on a periodic scheduled basis. An overriding manual control shall be provided to turn the fan on manually. The exhaust fan control will also be wired to an auxiliary contact from the battery charger such that when the battery charger is operating in equalize mode the exhaust fan will be turned on.

- 6.12 Provisions for a wall-mounted intake louver with area of not less than 144 square inches, installed as shown on the drawings, including a motorized damper controlled by the exhaust fan timer and manual controls and a screen with insulated cover for use during the winter. Louvers are to be factory finished to match the building trim color. Please note this building is using sealed batteries and the intake louver is not required at this time.
- 6.13 HVAC – A thermostatically controlled heating, ventilation, and air conditioning (HVAC) system with an economizer shall be provided. It shall consist of one or more individual units located as indicated on the drawings. The Contractor shall determine the heating and cooling capacity required taking into account the site location, seasonal weather, the building and the equipment in the building, and if necessary, revise the number of HVAC units needed. The HVAC equipment shall be rated for 120/240 V AC single phase power and be capable of cycling fresh air controlled by a timer or external auxiliary contact. The HVAC unit(s) will be furnished with a single automatic control for both heating and cooling with manual override control and auxiliary dry alarm contacts suitable for use with 125 Volt DC wetting voltage to annunciate High and Low Temperature and HVAC Unit Fail alarms.
- 6.14 The building manufacturer and installation Contractor shall each be responsible for providing sufficient structural reinforcement as necessary to support the wall mounted equipment and ceiling mounted cable tray as shown on the drawings.
- 6.15 The Contractor shall provide and install the following items of safety equipment in the number and location shown on the drawings or as specified herein:
- Fire Extinguisher - The Contractor shall provide one (1) 20-pound class A-B-C dry chemical fire extinguisher. The fire extinguisher shall be mounted on the building wall near the entrance door as shown.
 - Smoke/heat detector, UL approved, 120 VAC powered and ceiling mounted as shown on the drawings with dry alarm contacts suitable for 125 Volt DC wetting voltage for SCADA indication. Gentex model 8100 or approved equal.
 - Emergency eyewash station located near station battery. Station shall be self-contained with two 32-ounce bottles of sterile saline eyewash solution. See the battery and charger specification Section 26 33 00 for additional information
- 6.16 Inside building lighting - Provide and install industrial type, surface mounted 4-foot LED lighting fixtures. The lighting shall maintain a lighting level of 40 foot-candles of light at a level of 30” above the floor. The lighting fixtures shall be equipped with removable protective covers. The building lighting will be controlled from switches with adjustable

automatic occupancy (motion) sensors mounted on the wall near the door(s). All switches shall be labeled to indicate the lights served.

- 6.17 Outside lighting - Provide 120V AC wall mounted weatherproof light fixtures with LED bulbs and photocell above outside entrance door, as shown on the drawings. The entrance light shall also be equipped with a motion detector. Each entrance light shall be controlled from a switch placed next to the door as shown, to override the motion detector and/or photocell and turn the light "ON" and "OFF".
- 6.18 Provide and install duplex receptacles. Interior convenience duplex receptacles shall not be GFI protected. They shall be rated 120 VAC, 20 amps, 3 wire and shall be located approximately every 8 feet on interior walls or as indicated on the drawings.
- 6.19 Provide and install a minimum of two (2) exterior convenience GFI receptacles, rated 120 VAC, 20 amps, 3-wire, provided with weatherproof exterior boxes. The location of these receptacles shall be within the fenced area along the west wall and shall be coordinated with the Owner and Engineer. These are anticipated to be mounted relatively high on the wall due to snow considerations.
- 6.20 Provide and install indoor, wall-mounted emergency/exit light fixture(s), Exide #XRC-2 or equal, as shown in the drawings. Each emergency light shall be self-contained, battery powered, and shall provide one foot-candle of illumination when measured 30" above the floor. The packs shall switch on automatically upon loss of AC power, shall provide a minimum 1.5 hours of continuous illumination, and shall recharge when 120 VAC power is restored.
- 6.21 Provide and install ladder type aluminum cable tray in the building, supported from the ceiling, as shown. Provide a cable tray riser on the interior building wall to mate-up with the ceiling cable tray. Smooth transitions shall be provided allowing cables in the tray to travel from one tray to another easily and to protect the cable. The electrical cable tray shall be minimum NEMA Class 8B, 24" wide x 6" high, aluminum ladder type construction. The cable tray shall be capable of supporting loads for equipment furnished by the Contractor and the Owner (75 lbs/ft minimum). Two (2) #4/0 AWG, 19 strand SD, bare copper cables through the cable tray shall be provided to ground equipment as required. The grounding cables shall be run through the cable tray, down into the conduit and direct buried junction box where they shall be bonded to the substation ground grid.
- 6.22 Alarm Contacts Junction Box – Provide a junction box with terminal blocks for the smoke alarm, HVAC fail and high/low temperature alarm contacts, and the hydrogen monitor alarm contacts called for in Section 26 33 00.
- 6.23 Furniture shall be provided as follows:
 - Wall-mounted drawing rack shelf, foldable to be flush with the wall, stainless steel or aluminum construction.

7 SHIPPING

- 7.1 The costs for transportation permits, crane fees, and setting/fastening of the building shall be included as part of the building cost.
- 7.2 The Engineer reserves the right to make a factory inspection before shipment of materials or equipment.
- 7.3 The equipment shall be shipped as fully assembled as possible. However, batteries should not be installed until after shipping or field assembly. The Contractor shall identify shipping splits.
- 7.4 If applicable, shipping crates shall be labeled with the project number, project name, and the building manufacturers numbering scheme.
- 7.5 Equipment and accessories shall be adequately anchored, braced, and packed to prevent damage from vibration, shock, or dampness that might reasonably be encountered in transportation and handling.
- 7.6 The Contractor shall notify the Engineer of its intention to ship at least fourteen (14) days prior to the expected ship date.
- 7.7 Materials and equipment shall be shipped F.O.B. the job site and are the responsibility of the Contractor.

8 INSTALLATION

- 8.1 The Contractor shall be responsible for providing and installing all items for the control building unless noted otherwise.
- 8.2 The Contractor shall install the building following the manufacturers recommendations and instructions.

9 MISCELLANEOUS

- 9.1 Building and equipment found to be out of compliance with this specification will be rejected and credited, replaced, or brought into full compliance at the Contractor's expense.

10 WARRANTY AND GUARANTEE

- 10.1 The building shall be constructed to meet or exceed state and local codes and shall be accompanied throughout production by the Contractor's comprehensive quality control program.
- 10.2 The Contractor shall guarantee that the completed building will have no defects in materials or workmanship for a period of one year from final completion of the substation.

- 10.3 The Contractor's warranty shall cover any defects of the building, and any defects or malfunctions of the HVAC equipment, except those caused by vandalism, improper maintenance, alterations by the Owner, Owner-furnished materials, or improper operation.
- 10.4 The Contractor's warranty on the paint finish shall include twenty years for rust perforation, fading and chalking, flaking, peeling, and checking.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 26 05 00 - BASIC MATERIALS AND METHODS

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Submittals
 5. Conduit
 6. Cable Tray
 7. Cable Trench
 8. Underground Duct Systems
 9. Low Voltage Wire and Cable
 10. High Voltage Cables
 11. Wiring Devices
 12. Outlet Boxes
 13. Junction Boxes
 14. Panelboards
 15. Metal-Oxide Varistors
 16. Nameplates and Signs
-

1 GENERAL

This section covers conduits, cable trays, cable trenches, underground duct systems, wire, cable, markers, nameplates and other equipment and systems.

2 RELATED SECTIONS

- Section 01 10 00 - General Requirements
- Section 03 01 00 - Cast-In-Place Concrete
- Section 26 05 43 - Trenching, Backfilling and Grounding
- Section 31 01 00 - Site Work

3 CODES AND STANDARDS

- National Electric Manufacturer's Association (NEMA)
- National Electric Code (NEC)
- Underwriters Laboratories (UL)
- National Electric Safety Code (NESC)
- Insulated Cable Engineers Association (ICEA)

4 SUBMITTALS

Refer to General Requirements, Section 011000. Submit shop drawings and/or product information for the following:

- All equipment provided by the Installation Contractor.

5 CONDUIT

Unless otherwise specified on the plans or in the specifications, conduits shall be in accordance with these requirements. If size is not indicated on the plans, conduits shall be sized in accordance with the NEC.

- 5.1 Galvanized rigid steel conduit shall be used above grade inside and outside. If specified to be used underground a protective coating of bitumastic or asphalt paint shall be applied to the conduit. Couplings, unions, and fittings shall be galvanized. Conduit bodies shall be weatherproof with gaskets and plated screws.
- 5.2 Rigid aluminum conduit may be used above grade inside and outside at the Contractors option. Do not use underground or embedded in concrete. Couplings, unions, and fittings shall be aluminum alloy. Conduit bodies shall be weatherproof with gaskets and plated screws.
- 5.3 Rigid polyvinyl chloride conduit (PVC), Schedule 40 unless otherwise indicated in the plans and specifications, shall be used above grade or below grade. The conduit shall be rated for 90°C conductors or cable and for use in direct sunlight. Screw type couplings recommended by the conduit manufacturer shall be used to join PVC and

steel or aluminum conduit. The transition point shall be six inches above the finished grade.

- 5.4 Liquid tight flexible metal or polyvinyl chloride conduit (PVC) conduit shall be used where shown on the plans, inside or outside, for short lengths between equipment terminal boxes and rigid conduit.
- 5.5 Install above grade conduits exposed inside and outside unless otherwise shown on the plans. Run parallel with or at right angles to lines of structures and buildings, unless otherwise shown on the plans, and support at minimum intervals of five feet in a manner approved by the Engineer. Avoid pockets in conduit runs as much as possible. Unless the equipment into which conduit connects has threaded hubs, terminate conduit with two locknuts and an insulated bushing. Install expansion fittings in conduit runs over 10 feet.
- 5.6 Install direct buried conduit at a depth of 30 inches below finished grade unless shown otherwise on the plans. Conduit shall be bedded in sand with a minimum of 3 inches of fine sand all around.

6 CABLE TRAY

When shown on the plans cable tray shall be latter type with solid side rails, hot dip galvanized after fabrication or aluminum, with supports, couplings, elbows, tees, dropouts, and other fittings as required. Size and other requirements specified on the plans.

7 CABLE TRENCH

- 7.1 When shown on the plans trench shall be precast concrete type as manufactured by Trenwa, Inc., size as shown on the plans. Provide ground cable clips.
- 7.2 Install in accordance with the manufacturer's instructions and as shown on the plans. Excavate and backfill in accordance with Section 310100 and 260543. Install sand or gravel, bedding, and underdrain, if required, and conduit entrances as shown on the plans. Install a minimum 4 inches bedding of fine sand in the trench to form a level bottom, just covering the frame members.

8 UNDERGROUND DUCT SYSTEM

When shown on the plans underground duct systems shall be concrete encased type complete with manholes and handholes as shown in the plans.

- 8.1 Ducts shall be Type EB for concrete encasement with plastic duct spacers furnished by the duct manufacturer, Carlon Type EB Power and Communications Duct or equal. Use duct endbells at duct terminations in manholes. Duct spacing, concrete cover and burial depth shall be as shown on the plans.
- 8.2 Manholes shall be precast type. The minimum size and design requirements are as shown on the plans. Provide galvanized steel ladder and supports, galvanized steel

pulling irons opposite each duct entrance, galvanized steel channel inserts for cable supports, and cable support brackets. Place channel inserts full length vertically, two on each side on manhole.

- 8.3 Install duct runs straight except as shown on the plans, sloped to avoid low spots and provide good drainage. Duct bank may be poured without forming provided trench walls do not cave. Tie down ducts to prevent floating during concrete pouring. Use manufacturer's spacers to maintain duct spacing. Pour each section of duct bank complete in one operation if possible. Begin pouring at one end toward the other end to allow free end to move. Do not encase from each end toward the center. Do not use mechanical vibrator.
- 8.4 Pull a mandrel through each duct after completing construction of the duct bank to clean the ducts. Mandrel shall be 1/4 inch smaller in diameter than the duct. If obstruction is encountered, or if there is evidence of a water pocket, that section shall be rebuilt at no cost to the Owner.

9 LOW VOLTAGE WIRE AND CABLE

Low voltage power, control and instrumentation conductors shall be sized as indicated on the Plans or in the Specifications and shall meet the requirements specified below.

9.1 Single conductor in conduit above grade:

- 9.1.1 Minimum size #14 solid or stranded copper; #10 and larger stranded copper only, cross-linked polyethylene insulation, 600 volt, 75°C wet/ 90°C dry temperature rating, Type THHN/THHW. Color coding shall be in accordance with NEC.

9.2 Multi-conductor control cable above and below grade:

- 9.2.1 Minimum size #14, stranded copper, 600 volt, 90°C temperature rating, wet or dry, for use inside or outside, covered or in direct sun light, in wet or dry locations, in tray, conduit, duct or direct burial.
- 9.2.2 30 mil cross linked polyethylene or ethylene propylene insulated and 45 mil polyethylene or neoprene cable jacket.
- 9.2.3 Color coding compounded in the insulation, not surface coated. Color-code in accordance with ICEA Method 1, Table E-1, (B, W, R, G) for 4 conductors or less, Table E-2 for 5 or more conductors unless noted otherwise on the plans.

9.3 Power and lighting cables above and below grade and direct buried:

- 9.3.1 Multi-conductor, cross-linked polyethylene insulation (Type TC-THHN/THHW), PVC jacket, for use inside or outside, in wet or dry locations, in tray, conduit, duct or direct burial.

9.4 Instrumentation cable:

- 9.4.1 Minimum size #18 stranded tinned copper, 600 volt minimum, shielded, 90°C temperature rating wet or dry, for use inside or outside, covered or in direct sun light, in wet or dry locations, in tray, conduit, duct or direct burial.
- 9.4.2 Shield of metalized foil or tinned copper braid providing 100 percent coverage against noise with a copper drain wire on each pair.
- 9.4.3 Single pair cable: Twisted, 15 mil PVC insulation, 4 mil nylon jacket, shielded, and 45 mil minimum PVC cable jacket. Color-code black and red.
- 9.4.4 Multi-conductor cable: 15 mil PVC insulation, 4 mil nylon jacket, overall shield, and 45 mil minimum PVC cable jacket. Color-coded in accordance with ICEA Method 1, Table K-2.
- 9.4.5 Multi-twisted shielded pair cable shall be similar to item 9.4.4 above except it shall have an overall shield over the individual shielded pairs.
- 9.5 Internal Switchboard Wire: Minimum #14 AWG, 600 volt insulation, Type SIS.
- 9.6 Coaxial cable: Type RG-8U, 7 strands of #21 copper.
- 9.7 All connections terminating at terminal blocks shall have compression insulated ring type terminations. Compression terminals shall be installed with a tool designed for the purpose and equipped with a ratchet or equivalent device to ensure full compression before the tool can be released.
- 9.8 Each multi-conductor cable shall be permanently marked at each end and in pull boxes and junction boxes with the cable number as listed in the Cable Schedule. Cable markers shall be embossed, self-adhesive, plastic labeling tape, Dymo or equal. Color of the cable markers shall contrast with the cable jacket. Secure labels to cables using plastic electrical insulating tape wrapped around the cable at both ends of each label.
- 9.9 No splices shall be made in cable unless authorized by the Engineer. When authorized, they shall be made only at boxes, outlets, panelboards, cabinets, cable trenches, or cable trays. All splices or joints shall be covered with insulation equal to that of the insulated conductors. Splices may be of the crimped or compression type. Wire and cable shall be spliced or jointed so as to be mechanically and electrically secure.

10 HIGH VOLTAGE CABLES

- 10.1 High voltage power cable shall be sized as indicated on the Plans or in the Specifications and shall meet the requirements specified below.
- 10.2 Cable in duct or conduit shall be 15 kV, shielded, 90°C rating, UL Type MV-90, copper conductor semi-conducting conductor strand screen, ethylene-propylene (EP) insulation, 133 percent insulating level, insulation screen, copper shielding tape,

- polyvinylchloride (PVC) jacket, meeting the requirements of ICEA and AEIC, Okonite Okoguard-Okoseal, Kerite SPS, or approved equal. The cable shall be sun light resistant, suitable for conduit, cable tray or direct burial.
- 10.3 Cable terminators shall be 3M Quick Term III or approved equal for outside terminations. Terminators shall be furnished and installed in accordance with the manufacturer's recommendations.
 - 10.4 Cables shall be installed with cable grips or other means so that the weight of the cable is not supported by the termination.
 - 10.5 Cables in parallel must be installed in measured, equal lengths.
 - 10.6 Contractor shall perform high voltage direct current (DC) proof testing on cables after installation in accordance with accepted testing practices and as follows:
 - 10.6.1 Tests shall be performed only by qualified persons trained in high-voltage cable proof testing.
 - 10.6.2 Before performing the high voltage DC tests "Megger" the cable to be tested. Any cable which exhibits low "Megger" readings is questionable and should be cleaned before the high voltage DC test is performed.
 - 10.6.3 Bring the DC voltage up to prescribed test level in five (5) equal steps. Raise the voltage at an even rate, so as to reach the required step level in less than 10 seconds. Hold the voltage at each step for 60 seconds. Read and record the leakage current at the end of each hold period.
 - 10.6.4 Hold the full test voltage for not less than 10 minutes or more than 15 minutes. Read and record the leakage current at 15 second intervals for the first 2 minutes and then every minute for the duration of the test.
 - 10.6.5 Bring the test voltage control quickly and smoothly to zero. Read and record the voltage remaining on the cable after 30 seconds and 1 minute.
 - 10.6.6 Record all data concerning the cable tested and the test results and submit two (2) copies to the Engineer and two (2) copies to the Owner.

10.6.7 DC test voltages shall be as follows:

Cable	Insulation Thickness (Mil)	DC Test Voltage (kV)
5 kV	90	28
	115	36
8 kV	115	36
	140	44
15 kV	175	56
	220	64
25 kV	260	80
	320	96

11 WIRING DEVICES

11.1 Switches: Specification grade, 20 amperes, 1 pole, 2 pole, or 3-way as shown on the plans, with metal plates. For DC use 2-pole rated 125 VDC. Switches for the substation building interior lighting shall be three-way where required.

11.2 Receptacles: Specification grade, duplex type, 20 ampere, 125 Vac, with metal plate. For outdoors provide 20 ampere GFI type receptacles with weather-proof lift lid cover plates.

12 OUTLET BOXES

Size in accordance with NEC requirements. Indoors use galvanized steel. Outdoors or wet indoors areas use cast metal boxes with threaded conduit hubs.

13 JUNCTION BOXES

Provide junction boxes where shown on the plans. Boxes shall have hinged doors with gaskets, an interior removable panel for mounting equipment and shall be as manufactured by Hoffman Engineering Co., or approved equal. Provide terminal blocks, fuses and other equipment shown on the plans.

13.1 Enclosures shall be NEMA Type 1 for indoor use and NEMA Type 4 for outdoor use.

13.2 Doors with handles shall be lockable. Doors with cover clamps shall have captive hardware.

13.3 Terminal blocks shall be heavy duty, washer head connecting screw type, #10 screw, 30 ampere, 600 volt, with insulating barriers and marking strips, General Electric Type EB-25 and/or EB-27 (shorting type) or approved equal. Provide legible permanent marking on the terminals.

13.4 Fuse blocks and fuses shall be class RK5 suitable for use on 250 Vac or 125 Vdc systems. Fuses shall be Bussman Type FRN or approved equal.

13.5 Current and potential test switches shall be ABB type FT-1 switches.

14 PANELBOARDS

AC and DC circuit breaker panelboards will be provided by the contractor. All panelboards shall be from an approved manufacturer and shall be factory assembled. Load center type panelboards are not acceptable. Main lugs or main breaker, branch breakers and spare space shall be as shown on the plans.

14.1 Enclosures shall be surface mounted, NEMA Type 1 for indoor use and NEMA Type 4 for outdoor use.

14.2 AC panels shall be single-phase, 3-wire, 120/240 Vac, Square D Type NQ with QOB branch breakers or approved equal. Breakers for convenience outlets shall be equipped with ground fault interrupters (GFI).

14.3 DC panels shall be 125 VDC, 2-wire, Siemens Type P1 with BQD branch breakers or approved equal.

14.4 Complete the circuit directory inside the door, typed or neat legible lettering.

15 METAL-OXIDE VARISTORS

Where shown on the plans provide metal-oxide varistors connected from conductor and/or shield to ground.

15.1 Varistors to be 320 Vac, 160 Joules, General Electric catalog number V320LA40B or approved equal.

15.2 Use insulating sleeves on pigtails. Use compression type connector with insulated sleeve for connections to terminal strips. Use insulated compression type splice for connection of pigtail to insulated grounding wire.

16 NAMEPLATES AND SIGNS

Nameplates and labeling will be provided by the Contractor. Fence signs will be provided by the Owner. Nameplates on the relay panels will be provided by the relay panel manufacturer.

16.1 Identifying nameplates: Indoor locations shall use 1/8-inch black plastic laminate with white core, beveled edges, engraved with white letters. Outdoor locations shall use UV and fade resistant stickers specifically designed for outdoor use made by 3M or an approved equal. All colors, sizes and labels shall be approved by the owner before purchase/installation. Locations include:

16.1.1 Any indoor equipment provided by the contractor requiring standard maintenance or switching.

- 16.1.2 Number identification on all circuit breakers.
- 16.1.3 Number identification on all switches.
- 16.1.4 Phase identification on major equipment, buses, switches, fuses, and instrument transformers.
- 16.1.5 "Open" and "Closed" identification adjacent to switch operating handles.

Lettering for substation equipment and switch numbers shall be at least an inch high. Lettering for phase markings shall be at least two inches high.

16.2 Fence and door signs: Weather and sun light resistant embedded fiberglass signs rated a minimum of 20-year life span, meeting the requirements of OSHA Standard 1910.145 and ANSI Z535. Coloring shall be black lettering on orange background for action words and white background for the remainder of the sign. Signs shall be proven to remain readable for a minimum of 15 years when mounted outdoors.

16.2.1 "Warning High Voltage Inside Keep Out" signs. Approximate size 14" high x 20" wide x 1/8" thick, located on the gates, fence, building and doors spaced not more than 40 feet apart around the periphery of the substation fenced area, or as indicated on the drawings. A detail of the sign is shown on the Fence Detail drawing. Uticom sign U1420W-G-22R or approved equal.

16.2.2 "Warning/PPE Required" sign. Approximate size 14" high x 20" wide x 1/8" thick, located on the gates, fence and doors to the substation and switchgear building. A detail of the sign is shown on the Fence Detail drawing.

16.3 Mounting.

16.3.1 Fence - Attach all four corners with #9-gauge solid, galvanized steel wire ties.

16.3.2 Structures - Brass machine screws or beam clamps.

16.3.3 Equipment and building - Brass machine screws or other as required by the door manufacturer.

16.3.4 Signs shall be mounted on the outside of the fence.

END OF SECTION

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DIVISION 26 - ELECTRICAL

SECTION 26 05 43 - TRENCHING, BACKFILLING, AND GROUNDING

SECTION INDEX

1. General
 2. Products
 3. Execution
-

1 GENERAL

- 1.1 Applicable provisions of Division 1 apply to work in this section.
- 1.2 This Contractor shall provide all materials, labor, tools, equipment, and transportation required to furnish and install a complete new underground raceway system.
- 1.3 The approximate location of each manhole, junction box, duct bank and conduit run is shown on the drawings. The Contractor shall lay out his work and make all measurements required to fit his work with the field conditions. He shall take all levels necessary and establish proper grade and line on duct system and manhole. Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- 1.4 Provide as detailed on the drawings and specified herein, all required excavation and trenching for the underground conduit and ducts.
- 1.5 Fire and Traffic Lanes. Closing of roads, drives, alleys and parking areas shall be minimized. This Contractor shall cooperate with State personnel in maintaining open lanes on all roads, alleys or drives which are involved in this construction.
- 1.6 Existing Road, Sidewalks, Curb, and Gutter, Etc.
 - 1.6.1 It is the intent that all road surfaces disturbed by this installation shall be restored. Replace all curb and gutter damaged by this installation.
 - 1.6.2 Any installation such as fences, steps, drives, curbs, etc., on adjacent properties or removed as a result of this installation shall be properly restored by this Contractor.
 - 1.6.3 The Contractor shall use every reasonable precaution to prevent injury to roads, curbs, walks and all underground structures such as pipes, conduits, sewers and drains.
- 1.7 Clearing the Site. The Contractor shall clear the site within the construction limits of all features which, in the opinion of the Engineer, interferes with the construction work, and shall do all other clearing called for on the plan or specified.

2 PRODUCTS

- 2.1 Conduits - for MV cables
 - 2.1.1 The raceway system will consist of PVC conduit or ducts in sections as noted on the drawings. All sections shall be encased in concrete if noted on the drawings. PVC used in the raceway system shall be equal to "Carlson" Type 40 heavy wall rigid conduit, and have a minimum wall thickness of .280", designed to the latest NEMA standards.
 - 2.1.2 PVC duct shall be Carlson or approved equal. Styrene duct will not be acceptable.

2.2 Manhole Grounding

- 2.2.1 Each primary manhole shall have an effective grounding electrode installed. The grounding electrode shall be a minimum 5/8" x 10' copperweld ground rod complete with cable to copper rod connectors.
- 2.2.2 Grounding of equipment in manholes shall be grounded with a #4/0 AWG (minimum) soft drawn, shaped bare copper conductor.
- 2.2.3 Provide and/or extend a ground bus in all vaults and equipment rooms for the new equipment. Bus shall be 1/4" x 2" copper mounted 12" above the floor on wall standoffs. Bus shall be continuous, using equivalent bare copper wire minimum. Connect to ground bus. Bond all concentric neutrals to ground bus with appropriately sized grounding fittings. All fittings shall be of the compression type, Burndy Hi-Grade or equal.
- 2.2.4 Cables shall be racked as high as possible in manholes not to exceed 4' intervals, utilizing porcelain cable clamps, Unistrut Series 400 or equal.

3 EXECUTION

3.1 Excavation and Trenching Work

- 3.1.1 The Contractor shall excavate whatever materials are encountered as required to place the new construction at the elevations shown on the drawings.
- 3.1.2 Extend excavation outside of walls and other work far enough to permit the proper placing, inspection, and completion of all work. All concrete will be poured in forms unless specifically noted otherwise in this specification.
- 3.1.3 All black dirt or topsoil in excavated areas suitable for top dressing shall be excavated, stockpiled where directed, reserved for that purpose. Excavated material that is unsuitable or not required for filling shall be removed from the premises.
- 3.1.4 Material required for fill and suitable for this purpose shall be deposited where required.
- 3.1.5 If sides of trench excavation for underground concrete encased ducts are firm, they may be used for forms. If sides of trench sluff-off or cave in, wood forms shall be provided.
- 3.1.6 It is an absolute requirement that all ducts and conduits shall drain, unless noted, either to manholes or to direct buried junction boxes. Bottom of trench shall be graded to provide this drainage. Minimum slope for drainage shall be 6"/100'. No pockets shall be permitted, and any such conditions found shall be re-graded.
- 3.1.7 Trenches shall be cut on a straight line wherever possible. Spoil banks shall be at least 2' from edge of trench. All loose dirt shall be removed from edge of trench

before duct installation. Any loose dirt which falls into trench during or after the duct installation shall be removed by this Contractor before pouring concrete encasement.

- 3.1.8 Each excavated section shall be completely excavated and graded before ducts are laid. Wherever practical, excavate an entire duct run from manhole to manhole or to building.
- 3.1.9 Where it is necessary for the electrical duct lines to cross excavations made by others, this Contractor shall furnish and install compacted sand backfill to grade at bottom of duct trench. **NO ELECTRICAL DUCTS SHALL BE PLACED ON DIRT BACKFILL.**
- 3.1.10 The bottom of trench shall be hand graded and raked. **NO FRESH DIRT SHALL BE ALLOWED UNDER NEW DUCT SYSTEM.** In any area where existing grade is too low, or where excavations by others are in the path of the underground ducts, this Contractor shall haul in and install sand backfill to grade the bottom of trench.
- 3.1.11 This Contractor shall confer with other Contractors and arrange to place his excess dirt and spoil banks at locations which will not interfere with the accessibility to the installations.
- 3.1.12 Any water, gas, sewer, electric or steam lines encountered in the excavation, which are not to be disturbed, shall be properly underpinned and supported. Excavation Contractor shall exercise special care at locations of existing utilities as shown on the drawings. In areas where the duct bank crosses railroad tracks, the Contractor shall meet requirements as required by the railroad company.
- 3.1.13 The Contractor shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise in accordance with plan or original design.

3.2 Conduit Installation

- 3.2.1 After the trench is excavated and properly graded, the conduits shall be installed in the open trench.
- 3.2.2 Install Scotch electrical tape 2" wide, 1/2 lapped around coupling and extending 6" beyond sides of coupling. All conduit couplings shall be watertight.
- 3.2.3 Use large sweeps in primary conduit runs that are not straight. Any deflection in conduit runs of 5 degrees or less shall be made with an offset coupling. Deflections in excess of 5 degrees shall be made with manufactured offsets or bends.

3.3 Conduit Routing and Wall Penetrations

- 3.3.1 Use large sweeps in primary ducts and conduits as shown, where primary lines are not straight.

- 3.3.2 All conduits shall terminate flush in inside walls with end bells in all new construction or insulated bushings where core drilling is shown.
- 3.3.3 This Contractor shall core drill holes in existing footings, walls and manholes and waterproof same where new conduits are installed in existing construction.
- 3.3.4 Where indicated on drawings, continuous steel reinforcing shall be furnished and installed in duct sections. Reinforcing shall be threaded through spacers and tied to webs of spacers. Reinforcing shall overlap 18" minimum at joints.
- 3.3.5 All ducts, conduits and reinforcing steel shall be clean before any encasement is placed.
- 3.3.6 Generally, conduits and ducts shall be installed on gradients as shown on the drawings. However, it is anticipated that obstructions may be encountered which will require revisions in profile. Such changes in gradients shall be considered a part of the contract and no additions or deductions in contract price shall be negotiated for these changes. Only changes involving major relocations on plan or profile shall be subject to negotiation.
- 3.3.7 This Contractor shall be responsible for the proper placement of the ducts and conduits and shall closely supervise them during the duct placement operations.
- 3.3.8 All ducts shall drain, unless noted, either to manholes or to buildings. No pockets shall be permitted in duct lines.
- 3.3.9 After manholes and duct systems are complete, this Contractor shall pull a mandrel through all ducts and conduits 1/4" less in diameter than the duct or conduit. In case any obstruction prevents passage of this mandrel or in case it is indicated that there is water pocket in the duct, that section shall be located, removed and new encased duct or conduits encased in concrete installed.
- 3.3.10 Install one nylon "fish" line in all empty ducts and conduits.

3.4 Backfilling

3.4.1 Filling and Backfilling:

- The bottom of trenches and other areas which are below the finished grades shall be filled with sand. Filling must be deposited in horizontal layers and compacted sufficiently to prevent settlement. Machine compaction shall be used.
- Backfill on top of the new duct installation shall be clean, excavated earth, free from rock, debris, frozen materials, etc., except that sand shall be used for backfill under railroads, roads, sidewalks and parking lots. Backfill shall be placed in 6" layers and compacted to 95% maximum density. Material for backfilling over conduit sections under railroads, streets, driveways, and paved areas shall be sand with 6" layer of crushed rock on top and the permanent surface (blacktop, concrete, etc.) placed in 6"

layer on crushed rock. This Contractor shall hand rake the area in the vicinity of excavations, restoring original grade and removing rocks and debris. Original sod areas shall have minimum 4" of black dirt placed on them and shall be evenly graded.

- No backfilling shall be done until the outside of the exterior concrete manhole walls has been waterproofed as specified.
- No frozen materials shall be used in backfilling and no backfilling shall be done until all work has been inspected and the approval of the Engineer obtained to proceed with the backfilling.

3.4.2 Street and Walk Repairs: Contractor shall replace curbs, walks and pavement in the condition existing before construction. Sidewalk, pavement, curb and gutter replacement shall be backfilled with tamped sand.

3.4.3 Cleanup: Upon completion of his work, the Contractor shall remove his equipment and all surplus material and leave the premises in a neat and first-class condition. Dispose of all excess dirt, rock, concrete, rubbish, etc.

3.5 Grounding System

3.5.1 All grounding shall be installed in conformance with the latest edition of the Michigan Electrical Code, Article 250, Grounding, and all other related, applicable articles and standard practices.

3.5.2 All electrical system shall be grounded to ensure a permanent and continuous bonding together of all conductor enclosures, equipment frames, and other metallic non-current carrying parts of the electrical system. All PVC conduits shall contain a grounding conductor.

3.5.3 Each auxiliary system shall be grounded.

3.5.4 All grounds shall be permanently attached before the system is energized.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 26 33 00 - BATTERY AND CHARGER

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Submittals
 5. Battery
 6. Battery Accessories
 7. Batter Charger
 8. Safety Equipment
 9. Battery Sizing – Alternate
-

1 GENERAL

This section covers the station battery, battery charger and associated equipment and accessories.

2 RELATED SECTIONS

- Section 01 10 00 - General Requirements

3 CODES AND STANDARDS

- National Electrical Manufacturers Association (NEMA)
- Underwriters Laboratories (UL)
- American National Standards Institute (ANSI)

4 SUBMITTALS

Refer to Section 011000. Submit shop drawings and/or product information for the following:

- Battery
- Battery rack
- Charger

5 BATTERY

- 5.1 Sealed Valve Regulated Lead Acid stationary battery, 125 VDC nominal volts, heavy-duty type, 60 cells with a 10-year replacement warranty.
- 5.2 Minimum capacity rating of 100 ampere-hours at the 8-hour discharge rate and a minimum one-minute discharge rate of 75 amperes, at 77°F, 1.215 specific gravity, to 1.75 final volts per cell.
- 5.3 Cells shall have UL listed spark arresting vents.
- 5.4 Cells shall be individually identified with numbers a minimum of one inch high.
- 5.5 Furnish full charged and wet.

6 BATTERY ACCESSORIES

The following accessories shall be supplied by the manufacturer of the battery:

- 6.1 Two tier steel rack, painted with acid-resistant paint, with plastic or rubber covered supporting rails. The battery rack shall be rated for the seismic zone of the battery installation.

- 6.2 A stainless steel or acid resistant polymer pan shall be provided for installation underneath the battery rack to protect the floor surface from battery acid spills.
- 6.3 Intercell and interstep connectors.
- 6.4 Lead-plated copper lugs, including disconnectable compression type connectors to accommodate up to a 4/0 stranded copper cable for external connections.
- 6.5 Maintenance tools consisting of lifting devices and any special installation and maintenance tools. If flooded cell lead acid batteries are furnished, the contractor is to also furnish a vent-type hydrometer with suitable specific gravity scale, of the offset type if needed for batteries on the bottom, and a six inch minimum vent mounting thermometer with hard rubber vent plug and specific gravity correction scales.
- 6.6 Spare parts consisting of two extra bolt connectors and two extra intercell connectors.

7 BATTERY CHARGER

- 7.1 The charger shall be compatible with the battery and shall be designed for continuous parallel operation with the battery or disconnected from the battery.
- 7.2 Ratings:
 - 7.2.1 Input 240 Vac, 60 Hertz, single phase.
 - 7.2.2 Output 20 amperes at 130 Vdc.
 - 7.2.3 Continuous operation at rated output at ambient temperatures of 0 to 45°C.
- 7.3 Features and Accessories:
 - 7.3.1 All solid-state electronic devices.
 - 7.3.2 Full wave silicone rectifier.
 - 7.3.3 Output voltage regulator capable of maintaining the output voltage within a range of plus or minus 1.0 percent of the output voltage setting for all combinations of the following conditions:
 - No-load to full-load capacity.
 - Output voltage set between 122 to 140 volts.
 - Input voltage variation of plus or minus ten percent from 240 volts.
 - Input frequency variation of plus or minus five percent from 60 Hertz.
 - 7.3.4 Current limiter to limit the output to approximately 115 percent of the rated full-load charging current. The protective breakers shall not trip under this condition.

- 7.3.5 Battery eliminator filter to allow the charger to carry the normal substation load with the battery disconnected.
- 7.3.6 Capable of resuming normal operation on return after interruption of the input power supply, without operation of its protective breakers.
- 7.3.7 Power and control circuits shall be protected from voltage transients by solid-state surge suppressors to meet the performance requirements of ANSI Standard C37.90.1.
- 7.3.8 DC output filter to limit the AC ripple content to 30 mv RMS or less under all conditions with the charger connected to the battery.
- 7.3.9 "Fail Safe" circuitry capable of discontinuing charger output current in the event that the charger output voltage exceeds 2.35 volts per cell.
- 7.3.10 Potentiometer for adjustment of float and equalizing voltage.
- 7.3.11 Equalizing switch with timer adjustable from 0 to 72 hours.
- 7.3.12 Ground detector switch using DC voltmeter and positive and negative ground indicating lights, to be located on the battery side of the DC output circuit breaker.
- 7.3.13 Direct-current voltmeter and direct-current ammeter each with an accuracy of plus or minus one percent to monitor output.
- 7.3.14 Both AC and DC circuit breakers.
- 7.3.15 Alarm contacts for:
- DC Power Failure
 - AC Power Failure
 - Low DC Voltage
 - High DC Voltage
 - Positive Ground
 - Negative Ground
 - Alarm Summary
- 7.3.16 Auxiliary contact rated 10 Amps at 120 AC to open the vent and turn on vent fan when the charger goes into charge equalize mode.
- 7.3.17 The charger shall be capable of continuous operation at 115 percent of rated output current at an ambient temperature of 40°C using only convection cooling.
- 7.3.18 Sound level not to exceed 65 dBA at any point 5 feet from any vertical surface of the cabinet.

7.4 The charger cabinet shall be designed for wall mounting and provide easy access to internal components from the front. All equipment and terminal blocks shall be marked with the designations shown on the manufacturer's drawings.

8 SAFETY EQUIPMENT

8.1 Face shield equal to MSA "Sightgard" No. 456574 with 11-1/2x 6 x .040 in. clear cellulose acetate visor, No. 456576.

8.2 Synthetic rubber - coated apron, 33" x 36" with neck strap, equal to MSA No. 37676.

8.3 Portable eye wash station, personal type, gravity operated criss-cross stream, minimum 6-gallon storage, with drain hose, conforming to ANSI 235811 requirements for Personal Eye Wash Units, Fendall Porta-Stream I or approved equal.

9 BATTERY SIZING - ALTERNATE

The base bid should be provided with the battery system as specified. Alternate battery sizing will be considered provided the manufacturer provides detailed information on the alternate. If an alternate is quoted it should be clearly listed as such in the bidding documents.

END OF SECTION

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SECTION 31 01 00
SITE WORK



Debra L. Nelson
3-23-2023

PART 1 GENERAL

1.1 DESCRIPTION

- A. Preparing site for construction and restoration upon completion of the Work.
- B. Providing, moving, placing, and compacting fill materials in accordance with the lines, grades, thicknesses, and typical sections shown on the Drawings.
- C. Excavating, moving, loading, hauling, regrading, stockpiling, and/or disposal of surplus excavation materials, including finish grading to the extent and elevations shown on the Drawings.
- D. Installation and maintenance of erosion control measures throughout the project until vegetation is established.
- E. Purchasing, ordering and scheduling shipments of, geotextile, geosynthetic clay liner, Barrier Boom materials, and drain piping, unloading, on-site storage, installation and quality control.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D 1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 2. ASTM D 6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - 3. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 4. ASTM D 6913 – Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
 - 5. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- B. State of Michigan Department of Transportation (MDOT):
 - 1. Standard Specifications for Construction, 2020 edition.
- C. Geotechnical Investigation for Proposed Irontown Substation, Coleman Engineering Company, September 16, 2022.
- D. MDOT Soil Erosion and Sedimentation Control Manual, March 2021.
- E. Michigan Department of Environment, Great Lakes, and Energy (EGLE) Michigan Nonpoint Source Best Management Practices (BMP) Manual.
- F. Geosynthetic Institute (GRI) Standard Specifications.

1.3 GENERAL REQUIREMENTS

- A. Perform Work in a manner that minimizes disruptions to the operation of the Site, adjacent properties, and right-of-ways.
- B. Perform Work in compliance with federal, state and local codes, zoning laws and other applicable regulations.
- C. Notify public utilities and the Michigan Utility Notification System (MISSDIG 811) at least three full business days before starting earthwork activities. Verify utility markings prior to and during Work activities. Contractor is responsible for damage to public utilities or subterranean structures, including property damage or environmental damage resulting from damage to public utilities or subterranean structures and other incidental damage, if Contractor fails to obtain markings of public utility lines or subterranean structures, or if Contractor performs the Work in disregard of utility or structure markings, or if Contractor is otherwise negligent in performing the Work.
- D. Locate and mark private utilities and subterranean structures in the areas of the Work. Contractor is responsible for damage to private utilities or subterranean structures, including property damage or environmental damage resulting from damage to public utilities or subterranean structures and other incidental damage, if Contractor fails to obtain markings of private utility lines or subterranean structures, or if Contractor performs the Work in disregard of utility or structure markings or if Contractor is otherwise negligent in performing the Work.
- E. Do not remove or relocate utilities unless specified in the Contract Documents. Remove, plug, or cap inactive or abandoned utilities encountered during Work as directed by the affected utility company.
- F. Supply necessary compaction and grading equipment required to meet these Specifications and perform the Work specified in the Contract documents.
- G. Do not extend Work, disturb land, or stockpile materials beyond property or easement limits unless approved by Engineer.

1.4 QUALITY ASSURANCE

- A. Provide laboratory and field testing services as required by this section.

1.5 SUBMITTALS

- A. Submit geotechnical laboratory results for each imported fill material to Engineer 2 weeks prior to filling.
 - 1. Gradation results for all fill materials
 - 2. Modified Proctor results for aggregates and granular materials
 - 3. Void ratio results (oil containment aggregate only)
- B. Submit product specification and properties sheet for the following materials to Engineer at least 2 weeks prior to installation:
 - 1. MDOT Section 910 stabilization geotextile fabric
 - 2. Oil containment geotextile fabric
 - 3. MDOT Section 910 geotextile liner
 - 4. C.I. Agent/BCI Barrier Boom

5. Geosynthetic clay liner (GCL)
 6. Erosion controls
- C. Submit three copies of field inspection and test results to Engineer. Include:
1. Report date.
 2. Name, address, and phone number of laboratory.
 3. Name and signature of laboratory inspector.
 4. Project name and location.
 5. Date and time of sampling or inspection.
 6. Temperature and weather conditions at time of field testing.
 7. Date of testing.
 8. Identification of product and Specification section.
 9. Location of sample or test.
 10. Type of test or inspection.
 11. Results of test.
 12. Interpretation or observation of testing results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

- A. Dense-Graded Aggregate:
1. Conform to MDOT Standard Specifications, Section 902 – Dense-Graded Aggregate Class 23A or 23AA.
 2. Only crushed stone materials derived from a quarried source will be accepted for use within the reinforced aggregate limits shown on the Drawings.
- B. Modified Open-Graded Aggregate:
1. Conform to MDOT Standard Specifications, Section 902 – Open-Graded Aggregate 4G, modified with 100% of material passing the 1-inch sieve, and a maximum of 5% of material passing the no. 200 sieve, based on dry weights.
 2. Only crushed stone materials will be accepted. Crushed gravel or other crushed materials will not be accepted without prior written approval of the Engineer.
- C. Granular Material:
1. Conform to MDOT Standard Specifications, Section 902 – Granular Material Class II.
 2. Only crushed stone materials will be accepted.
- D. Oil Containment Aggregate:
1. Conform to MDOT Standard Specifications, Section 902 – Coarse Aggregate Class 17A.
 2. Provide well graded coarse aggregate conforming to gradation for AASHTO M43 size no. 67, and having a minimum void ratio of 0.43.
 3. Provide only non-calcareous stone.
- E. Native Soil Backfill:
1. Excavated native soil and existing soil fill material free of contamination, objects greater than 3-inches in diameter, frozen material, foreign materials including metal, organics, peat, topsoil, and free liquids.

- F. Topsoil:
 - 1. Salvaged topsoil from the site, or
 - 2. Conform to MDOT Standard Specifications, Section 917 – Landscaping Materials, Topsoil.
 - 3. Topsoil testing not required unless directed by Engineer.
- G. Imported General Fill:
 - 1. Materials free from organic matter and refuse, masonry, metal, sharp objects, boulders, snow, and ice.
 - 2. No solid material larger than 6 inches in its largest dimension.
 - 3. General fill may be used for fill with prior written approval of the Engineer.
- H. Plain Riprap:
 - 1. Conform to MDOT Standard Specifications, Section 916, Plain Riprap.
- I. Coarse Aggregate 3x1:
 - 1. Conform to MDOT Standard Specifications, Section 916 – Coarse Aggregate 3x1.

2.2 EROSION CONTROL

- A. Silt Fence:
 - 1. Conform to MDOT Standard Specifications, Section 916 – Erosion and Sediment Controls, Silt Fence.
- B. Mulch:
 - 1. Conform to MDOT Standard Specifications, Section 917 – Landscaping Materials, Loose Mulch.
- C. Erosion Control Blanket:
 - 1. Conform to EGLE BMP Manual Erosion Control Blanket Type 1A.
- D. Fertilizer:
 - 1. Conform to MDOT Standard Specifications, Section 917 – Landscaping Materials, Fertilizer.
- E. Temporary Seed Mixture:
 - 1. Conform to MDOT Standard Specifications, Section 917– Seed, Temporary Seed Mixture CR, TSM 6/24, or TSM 24+ depending on the expected duration of temporary seeding as approved by Owner.
- F. Permanent Seed Mixture:
 - 1. Conform to MDOT Standard Specifications, Section 917– Seed, Seed Mixture TDS.

2.3 GEOTEXTILES

A. Stabilization Geotextile:

1. Woven or non-woven geotextile meeting MDOT Section 910 – Geosynthetics, Stabilization Geotextile.

B. Oil Containment Geotextile:

1. Non-woven geotextile meeting the following criteria:

Property	Units	Type of Criterion	Acceptable Value ¹
Apparent Opening Size	mm	Maximum	0.150
Grab Tensile Properties ²			
Tensile Strength	lb	Minimum	260
Break Elongation	%	Minimum	50
Mass Per Unit Area	oz/yd ²	Minimum	10
Puncture (CBR) Strength	lb	Minimum	725
Trapezoidal Tear ²	lb	Minimum	100
UV Resistance ³	%	Typical	70

Notes:

1. Values are based on GRI GT12(a) and based on review of acceptable manufacturer's specifications and represent production values at the time this document was prepared.
2. These tests will be performed and results reported in both the machine and cross directions.
3. Evaluation to be on a 2.0 inch strip tensile specimens after 500 hours exposure.

C. MDOT Geotextile Liner

1. Geotextile meeting MDOT Section 910, Geotextile Liner.

2.4 PIPING

A. Oil containment system drain pipe:

1. HDPE perforated corrugated single-walled drain pipe with geotextile sock. Use ADS, Inc. or approved equal.
2. HDPE non-perforated corrugated single-walled drain pipe. Use ADS, Inc. or approved equal.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions where Work will be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 SITE PREPARATION AND MAINTENANCE

- A. Remove all rough brush, foliage, and other vegetation required to facilitate construction. Protect existing on-site trees. Complete clearing and grubbing in accordance with MDOT Standard Specifications, Section 201 – Clearing.

- B. Vegetation removal shall only be performed under the observation of the Owner or Engineer or with the Owner's approval.
- C. Separate vegetation from stripped topsoil. Topsoil may be stockpiled for later placement during restoration. Stockpile locations must be approved by the Owner or Engineer. Site disturbance must remain within the property.
- D. Vegetation removed to facilitate construction must be disposed of offsite. No open burning or burying of materials on site is allowed.
- E. Remove, temporarily relocate, and replace shrubbery, fencing, gates, and other landscaping as required to facilitate construction. Contractor is responsible for the preservation of these items and materials or shall replace them to the satisfaction of the Owner prior to the completion of the work.
- F. Proof roll all areas to receive fill and/or aggregates with a loaded tandem-axle dump truck having a minimum gross weight of 25 tons if the subgrade is cohesive or a minimum 10-ton smooth-drum vibratory compactor where cohesionless soil is encountered. Perform proof-rolling in perpendicular directions to provide complete coverage. Notify Engineer at least 24-hours prior to proof-rolling.
- G. Compact loose sand or gravel subgrade, and fill materials, with a large vibratory compactor. Stabilize soft areas observed during proof-rolling with Granular Material Class II compacted into the soft subgrade until little (if any) deflection is noted, as directed by the Engineer.
- H. Allow wet subgrade areas to dry before compacting and placing fill.
- I. Wet and/or soft silt and clay areas can be treated with quick lime, hydrated lime, or fly ash until stabilized. Any lime or ash material used to treat subgrade soils must be approved in writing by the Engineer prior to use.
- J. Keep work clear of water while structures are being built. Do not lay work in water unless provided in written approval from the Engineer. Do not allow water to rise around work until it is in a watertight condition.

3.3 EROSION CONTROL

- A. General
 - 1. Erosion control is the responsibility of the Contractor during construction and until acceptance of the project by the Owner.
 - 2. Erosion and sediment control measures, as shown on the Drawings, are the minimum required. Install additional measures determined necessary due to their execution of the work as requested by the local inspector or the Engineer within 24 hours.
 - 3. Remove all material tracked onto adjacent roadways by sweeping prior to the end of each work day.
- B. Stabilize soil stockpiles that are inactive for more than 7 consecutive days with seed and mulch, erosion mat, polymer, or covering with tarps.
- C. Provide temporary stabilization measures when land disturbing construction activities have temporarily ceased and will not resume for a period exceeding 14 days. Temporary stabilization may include temporary seeding, mulching, or chemical mulch binder. Apply temporary seed in accordance with Section 816 of the MDOT Standard Specifications.

D. Inspection

1. Inspect erosion controls with a certified storm water operator at least once per week, and within 24 hours after every precipitation event that results in a discharge from the site.
2. Complete an Inspection Report after each inspection and submit to Engineer.
3. Notify the Engineer in writing of needed corrective actions and conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected.

E. Installation

1. Install erosion controls in accordance with the Drawings and the Manufacturer's recommendations.
2. Provide and install erosion controls at the locations indicated on the Drawings.
3. Install erosion controls prior to commencing ground disturbing activities.

F. Maintenance and Removal

1. Maintain erosion controls in good working order through the life of the project.
2. Remove erosion controls when the site has been stabilized as notified by the Owner/Engineer.
3. All erosion controls removed become the property of the Contractor and the Contractor is responsible for all costs associated with the disposal of erosion controls.

3.4 EXCAVATION

A. General:

1. Excavate to the limits and depths shown on the Drawings.
2. Excavate other materials deemed unsuitable or undesirable for the construction as directed by the Engineer.
3. Removal of materials beyond the limits and depths shown on the Drawings without authorization of Engineer shall be at the Contractor's expense, including backfill and compaction.
4. Provide required sheeting and bracing, drainage, dewatering, and pumped water disposal required to protect the work and structures (above and below ground).
5. Remove and replace materials softened or loosened by exposure to water. These repairs will be completed at the Contractor's expense.
6. Refer to September 16, 2022, Geotechnical Investigation report for foundation subgrade requirements.

B. Perform all Work in accordance with OSHA requirements.

C. Surplus excavated materials that are not required or are unsatisfactory backfill materials for the work become the property of the Contractor. Surplus excavated materials must be disposed of off site at the Contractor's expense.

D. Promptly remove water accumulating at the base of excavations as a result of precipitation or groundwater seepage in undercut excavations by using pumps operating from filtered sump pits. Contractor is responsible for obtaining all permits required to complete dewatering activities.

- E. Rock excavation is defined in MDOT Standard Specifications, Section 205, and includes boulders with a volume of at least ½ cubic yard, rock or cemented soils that do not soften when wet or that cannot be removed without continuous drilling, blasting, or continuous use of a ripper or other special equipment.
1. Notify Owner prior to any rock excavation.
 2. Excavate rock in accordance with MDOT Standard Specifications, Section 205.
 3. Obtain written approval of the Owner and all necessary permits prior to blasting.
 4. Do not proceed with rock excavation until Owner or Engineer has completed necessary measures to determine the quantity of rock excavation required.
 5. Remove all soil, loose, or decomposed rock over the surface of the rock to be excavated prior to Owner/Engineer's measurements.

3.5 FILLING

A. General:

1. Carefully place fill material to protect underground structures and utilities.
2. During cold weather, protect exposed subgrades from freezing before or after footing construction.
3. Remove ice and snow before placing fill. Do not place fill on frozen subgrade.
4. Do not fill with frozen material.
5. Do not backfill excavation until an inspection has been made and backfilling authorized by the Engineer.
6. If fill settles below the adjacent ground surface, prior to one year following completion of Work, refill settled area and mechanically compact the surface.

B. Filling in Aggregate Areas:

1. Fill aggregate areas with materials indicated on the Drawings in lifts not exceeding 9 inches before compaction, mechanically compact to at least 90% of modified Proctor maximum dry density as defined by ASTM D 1557.
2. Place subgrade stabilization geotextile below aggregate/granular material as shown on the drawings.

C. Filling Around Foundations and Buildings

1. Refer to September 16, 2022, Geotechnical Investigation report for foundation subgrade requirements.

D. Fill in Grassed Areas:

1. Fill grassed areas with Native Soil Backfill, or with Imported General Fill if approved by Engineer, in lifts not exceeding 10 inches before to compaction, mechanically compact to at least 85% (for clay/silt) and 90% (for sand/gravel) of modified Proctor maximum dry density as defined by ASTM D 1557.

E. Testing:

1. Test fill for compaction on each lift of fill or as determined by the Engineer.
2. Field density testing shall be in accordance with ASTM D 6938.
3. Retest any failed tests after re-compaction.

3.6 GRADING

- A. Complete site grading during dry weather, or as approved by Engineer.

- B. Grade and finish to within 0.10 foot of grades provided for areas outside of the oil containment system footprint. Grade and finish to within 0.00 foot of grades provided within the oil containment system footprint.
- C. Blend slopes with existing landscape features at the intersection of cuts and fills; provide gradual slope between new and existing construction.
- D. Minimize construction traffic across prepared subgrades.

3.7 PIPING

- A. Set pipe to the elevations indicated on the Drawings.
- B. Install pipe in accordance with manufacturer's installation instructions.

3.8 GRASSED AREA RESTORATION

- A. Place topsoil, seed, fertilizer, and mulch to maximize the germination and viability of the grass seed, and minimize the soil and seed loss due to erosion.
- B. Install slope erosion mat on slopes 3 horizontal to 1 vertical and steeper.
- C. Topsoil/Salvaged Topsoil:
 - 1. Place topsoil/salvaged topsoil in accordance with MDOT Standard Specifications, Section 816 – Turf Establishment.
 - 2. Place and spread to a uniform minimum depth indicated on the Drawings or such greater depth as designated by the Engineer.
 - 3. Remove rocks, twigs, and other foreign material. Dress the entire surface to present a uniform appearance. Maintain minimum slopes.
- D. Seeding:
 - 1. Seed grassed restoration areas in accordance with instructions provided on the Drawings or MDOT Standard Specifications, Section 816 – Turf Establishment.
- E. Fertilizer:
 - 1. Seed grassed restoration areas in accordance with instructions provided on the Drawings or MDOT Standard Specifications, Section 816 – Turf Establishment.
- F. Mulching:
 - 1. Seed grassed restoration areas in accordance with instructions provided on the Drawings or MDOT Standard Specifications, Section 816 – Turf Establishment.
 - 2. Place mulch on seeded areas within 24 hours after seeding has been completed.
 - 3. Begin mulching at top of slope and proceed downward.
 - 4. Maintain mulched areas and repair areas damaged by wind, erosion, traffic, or other causes prior to final acceptance of work under contract.
- G. For the first 6 weeks after initial restoration of grassed areas, make provisions for watering restored areas as needed during dry weather.

END OF SECTION

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DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 31 00 - FENCES AND GATES

SECTION INDEX

1. General
 2. Materials
 3. Installation
 4. Warning Signs
 5. Grounding
 6. Field Engineering and Staking
-

1 GENERAL

1.1 Scope

Work covers the procurement and installation of a fence enclosure for an electrical distribution substation.

1.2 Codes and Standards

Codes and standards of the following organization are referenced herein:

- American Society for Testing and Materials (ASTM).

1.3 Testing

All parts shall be galvanized and shall withstand six one-minute immersions in copper sulfate per ASTM "Standard Method of Test for Uniformity of Coating by the Preece Test (Copper Sulfate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles", A239.

1.4 Design

The overall minimum height of the fence is to be 8 feet plus a foot of barbed wire for an approximate height of 9 feet.

2 MATERIAL

2.1 Fabric

The fence fabric shall be 8 feet high. It shall consist of a minimum No. 9 USWG steel wire, woven into a 2-inch square mesh. The minimum breaking strength of wire shall be 1200 lbs. The sides of the mesh pattern shall be approximately 45° to a vertical line.

The fabric shall be galvanized in accordance with ASTM A392, Class I.

2.2 Line, End, Corner, Pull and Gate Posts

All posts shall be steel and conform to the sizes as listed in Table A for the specific type of application.

Table A

FENCE POSTS FOR 8 FT. FENCE

<u>Use</u>	<u>Type</u>	<u>Minimum Size</u>
Line Posts	Round	2 3/8 in. OD; t=.154 in.; 3.65#/ft.
	Rolled or Formed Sections	Size so that bending strength about strong axis is not less than that of the round post
	Where called for in the plans and specifications the line posts shall be driven galvanized steel rolled formed "C" channel per ASTM F-143	2.25" X 1.7" @ 2.278 pounds / foot
End, Corner, Pull Posts	Round	2 7/8 in. OD; t=.203 in.; 5.79#/ft.
	Rolled or Formed Section	Size to that bending strength about weak axis is not less than that of the round post
Gate Posts (double gates widths to 12' wide)	Round	2 7/8 in. OD; t=.203 in.; 5.79#/ft.
	Rolled or Framed Section	Size so that bending strength about weak axis is not less than that of the round post
Gate Posts (double gates widths from 12' to 26' incl.)	Round	4 in. OD; t=.226 in.; 9.11#/ft.
	Rolled or Formed	Size so that bending strength about Section weak axis is not less than that of the round post

Tubular material should conform to ASTM A53, Grade B, for round shapes and ASTM A500, Grade B, or ASTM A501 for square shapes. Roll-formed sections shall meet the yield stress requirements of ASTM A36 as a minimum.

Line Posts and Gate Posts shall be of sufficient height to: (a) accommodate a 8-foot fabric; (b) accommodate extension arms, and (c) be embedded 3'-6" into the concrete footing.

Where the "C" channel line posts are called for in the plans and specifications they shall be driven line posts, driven to a minimum depth of 4 feet.

End, Corner, Pull Posts shall be of sufficient height to: (a) accommodate a 8-foot fabric; (b) accommodate extension arms, and (c) be embedded 4'-0" into the concrete footing.

Gate posts shall be of sufficient height to accommodate the fence fabric to match the line fabric and the extension arm height and be embedded 4'-0" into the concrete footing.

All tubular sections shall be hot-dipped galvanized in accordance with ASTM A120. Roll-formed sections shall be galvanized in accordance with ASTM A123.

2.3 Top Rail and Bottom Rail

Top rails shall be round steel pipe or tubing. The minimum size shall not be less than 1 5/8 in. OD nor have a minimum wall thickness less than .138 in. Lengths should be a minimum of 16 feet. Provisions for adequately joining lengths together and securing to end or corner posts shall be compatible for the physical size of the top rail. Couplings shall allow for expansion and contraction.

Top rails and hardware shall be galvanized in accordance with ASTM A120.

2.4 Extension Wire

Barbed wire shall consist of two strands of 12-1/2 USWG steel wire with 4-point barbs at a maximum spacing of 5 in. apart. The wire shall be galvanized after weaving in accordance with ASTM A121, Class 3.

2.5 Extension Arms

The extension arms shall extend upward and outward from the fence at an angle of 45 degrees. There shall be provisions for three equally spaced lines of barbed wire on the extended arms. The uppermost wire shall be approximately one foot vertically above the fabric and one foot outside the fence line.

The extension arm shall be made of pressed steel or malleable iron and should be capable of supporting a downward force of 300 lbs.

The extension arm shall be galvanized in accordance with ASTM A153.

2.6 Stretcher Bar

Stretcher bars shall be galvanized steel bars not less than 1/4 in. x 3/4 in. They shall be approximately 1 in. less than the fabric height.

The stretcher bar shall be used for securing the fabric to all terminal posts. One bar is required for each gate and end posts and two required for each corner and pull post.

2.7 Post Braces

Post Braces are required at each gate, corner, pull and end post. It shall consist of a strut, which shall not be less in size than the top rail, and a tension rod with turnbuckle. The rod shall be steel and have a minimum diameter of 3/8 in.

The strut shall be secured to the adjacent line post at approximately mid-height of the fabric. The tension rod is also secured near this area on the line pole and is anchored near the base of the corner post (or gate, pull or end post).

Bracing members shall all be hot-dip galvanized.

2.8 Tension Wire

Tension wire shall not be less than No. 7 USWG galvanized steel wire.

2.9 Gate Frames

Gate frames shall be constructed of tubular steel members which shall be welded at the joints. Additional horizontal and vertical struts may be required to provide for a rigid gate panel allowing for no visible sag or twist. Gate frames shall be made to have approximately 3 in. clearance above the road.

Fabric for the gate panels shall be the same as the fence.

Gate frame and bracing members shall not be less than the structural equivalent of 1.9 in. OD standard pipe. Steel tension rods and turnbuckles may also be utilized. Gate frame shall have provisions for three lines of barbed wire above fabric. All gate frame material shall be hot-dip galvanized.

2.10 Hardware

2.10.1 Hinges

Hinges shall be heavy duty and allow 180-degree swing of all gate leaves. The hinges shall not twist or turn under the action of the gate and shall provide ease of operation.

2.10.2 Latches, Stops, and Keepers

Latches, stops and keepers shall all be heavy duty construction of galvanize steel or malleable iron. Gates shall have parallel bar industrial latches with provisions for installing a pad lock. A keeper shall be provided which will secure the free end of each gate in the open position.

Hardware shall allow for gate operation for either side with provisions for securing with padlock.

2.10.3 Bands, Wire Ties and Clips

Bands, wire ties and clips for securing fabric to top rails, line posts, terminal posts and tension wires shall be galvanized steel and of adequate strength for the purpose intended. Aluminum wire ties of adequate strength are acceptable for this work also.

2.10.4 Hardware Materials

Hardware shall be formed of one of the materials tabulated below:

- a. Castings per ASTM "Standard Specifications"
 - "Gray Iron Castings", A48.
 - for "Malleable Iron Castings", A47.
 - for "Steel Castings", A27.
- b. Rolled, pressed, and forged steel: SAE 1025.

The hardware shall be hot-dipped galvanized per ASTM "Standard Specifications for Zinc-Coating (hot-dip) on Iron and Steel Hardware", A153.

- c. Fence and gate hardware shall be installed such that it cannot be removed from outside the substation.

3 INSTALLATION

3.1 Erection

The fabric shall be placed on the outside of the posts, stretched taut, and secured to the posts, top rail, and tension wire. The fabric shall be secured to the line posts with wire ties or metal bands at maximum intervals of 14 in. The top and bottom edges shall be secured, respectively, to the top rail and tension wire with tie wires not exceeding intervals of 24 in. The fabric shall be secured to terminal posts by means of the stretcher bar which is passed through the end loops of the fabric and is secured to the terminal posts by metal bands spaced at a maximum interval of 14 in.

Fabric for fencing shall all be either left-hand or right-hand weave. Rolls of fabric shall be joined together by weaving a single strand into the end of the roll to form a continuous piece.

The spacing of the line posts (10 ft. max.) shall be measured parallel to the ground. All posts shall be placed in a vertical position except as may be specifically designed otherwise, with the strong axis parallel to the fabric.

3.2 Concrete Footings

All posts shall be set in holes and backfilled with concrete. Concrete shall have a minimum compressive strength of 3000 psi at 28 days with a maximum size of aggregate of 1 in. The concrete shall be well worked (rolled) in the hole. The top of the footing shall be crowned to shed water away from the post.

Where called for on the plans and drawings the concrete fence post footings shall be formed in straight sided SONO tube and domed at ground level so as to shed water away from the post.

The minimum diameter of the concrete footings for line posts shall be 9 inches and 12 inches for corner and gate posts.

The minimum depth of the footing holes shall be 48 inches for line post and 60 inches for corner and gate posts.

4 WARNING SIGNS

The contractor shall provide and install warning and safety signs in accordance with section 26 05 00, as detailed on the plans and described in the bill of materials.

5 GROUNDING

Grounding shall be in accordance with the Plans and Specifications and will be furnished and installed by the below grade contractor, unless noted as being provided or installed by others.

6. FIELD ENGINEERING AND STAKING

The Contractor shall provide field engineering services to establish grades, lines, and levels using recognized engineering survey practices. The fencing contractor is responsible for staking the fence installation.

The Contractor shall notify the Engineer at least 48 hours in advance of initial field staking of base lines and grade so that, if desired, the Engineer can have a representative present to observe the results of the field staking.

The Owner reserves the right to change the placement of fence on the site at any time prior to start of the work and the Contractor shall not have any claims for any extras due to such changes; except, to compensate for any changes in quantities of material required.

END OF SECTION

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DIVISION 33 - UTILITIES

SECTION 33 09 70 - INSTRUMENTATION AND CONTROLS

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Submittals
 5. AMI Equipment
 6. SCADA System
 7. Telephone Service Facilities
 8. Testing and Calibration
-

1 GENERAL

This section covers instrumentation, controls, control switchboards, supervisory control, and data acquisition (SCADA) systems, communication systems, and appurtenant equipment.

2 RELATED SECTIONS

- Section 011000 - General Requirements
- Section 260500 - Basic Material and Methods

3 CODES AND STANDARDS

- National Electric Code (NEC)
- Other codes as required

4 SUBMITTALS

Refer to General Requirements, Section 011000.

5 AMI EQUIPMENT

5.1 The Owner will furnish and install the AMI equipment, if necessary.

6 SCADA SYSTEM

6.1 The Owner will furnish and install SCADA equipment as needed, other than the control wiring called out in the cable schedule.

7 TELEPHONE SERVICE FACILITIES

Telephone service, if required, will be provided by the Owner.

8 TESTING AND CALIBRATION

Testing of instrumentation and control system before it is placed into service will be done by an independent testing service retained by the Owner. The Contractor shall provide labor to complete the wiring as necessary during the testing process and to correct deficiencies which may be found. The Contractor shall cooperate in every way with testing service personnel. Scheduling of testing service personnel on site shall be coordinated with the Owner.

END OF SECTION

DIVISION 33 - UTILITIES

SECTION 33 72 26 - BUS AND ACCESSORIES

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Submittals
 5. Materials
 6. Bus System Installation
 7. Electrical Connections
 8. Aluminum Bus Welding
-

1 GENERAL

This section covers the substation bus system including busses, connectors, insulators, and accessories.

2 RELATED SECTIONS

- Section 007200 – General Conditions
- Section 011000 – General Requirements

3 CODES AND STANDARDS

- American Society for Testing Material (ASTM)
- National Electrical Manufacturers Association (NEMA)
- American Welding Society (AWS)

4 SUBMITTALS

Refer to General Requirements, Section 011000. Submit a list of connectors and fittings proposed to be used with product description sheets for products proposed other than specified.

5 MATERIALS

5.1 Rigid Bus:

- 5.1.1 Where indicated on the drawings, aluminum rigid tube bus shall be electrical grade Schedule 40 seamless aluminum pipe equal to 6063-T6 alloy in accordance with ASTM B345 in the sizes shown on the drawings.
- 5.1.2 Where indicated on the drawings, aluminum universal angle bus, (UABC) shall be type 6101-T6 alloy extruded aluminum, in the sizes shown on the drawings.
- 5.1.3 Where indicated on the drawings, copper rigid tube bus shall be electrical grade, hard drawn copper, 98% conductivity in the sizes shown on the drawings.

5.2 Bus Accessories:

- 5.2.1 Bus accessories for aluminum ridged tube bus, including supports, adapters, branches, tee and angle fittings, terminals, taps, couplers, corona bells, etc., for use with aluminum bus, or connecting aluminum to copper components shall be of aluminum alloy SG70A in accordance with ASTM designation B26 (Aluminum Association Alloy Designation No. 356.) Fittings utilized shall be designed for making bolted connections unless otherwise designated. All fittings shall be of the appropriate size for the specific application.
- 5.2.2 Welding of bus and bus fittings may be allowed but only with the approval of the engineer.

5.2.3 Bus accessories for copper ridged tube bus, including supports, adapters, branches, tee and angle fittings, terminals, taps, couplers, corona bells, etc., for use with copper components shall be of copper alloy. Fittings utilized shall be designed for making bolted connections unless otherwise designated. All fittings shall be of the appropriate size for the specific application.

5.3 Bolted Connections:

5.3.1 Bolted connections will be used only to connect bus to equipment or where specifically designated on the drawings. Terminal connector pads shall have bolt patterns in accordance with the latest NEMA Standard CCD-1, "Power Connectors for Substations."

5.3.2 Bolts for connecting aluminum to aluminum shall be 1/2" x length required aluminum or stainless steel.

5.3.3 Fasteners for connecting aluminum to copper shall be 1/2" x length required stainless steel bolts with silicon bronze nuts.

5.3.4 Bolts for connecting copper to copper shall be 1/2" x length required stainless steel bolts with silicon bronze nuts.

5.4 Corrosion Inhibiting Compounds: Corrosion inhibiting compounds utilized shall be No-Ox-Id or Penetrox-A.

5.5 ACSR Conductor: ACSR conductor shall be in accordance with ASTM B232 and B498.

5.6 Station Post Insulators: Light gray color.

- 15 kV - NEMA TR205, 110 kV BIL, 3-inch bolt circle
- 23 kV - NEMA TR208, 150 kV BIL, 3-inch bolt circle
- 34.5 kV - NEMA TR210, 200 kV BIL, 3-inch bolt circle
- 69 kV - NEMA TR216, 350 kV BIL, 3-inch bolt circle
- 115 kV - NEMA TR286, 550 kV BIL, 5-inch bolt circle
- 138 kV - NEMA TR288, 650 kV BIL, 5-inch bolt circle

6 BUS SYSTEM INSTALLATION

6.1 Install bus, cable jumpers, fittings, and all connectors in complete accordance with recommendations of the manufacturer (and subject to approval of the Engineer) unless otherwise specified.

6.2 Stranded conductor shall be installed without twists or kinks and shall be handled to avoid abrasions or other damage. Damaged conductor, tubing, or fittings shall be replaced or repaired to the satisfaction of the Engineer. No splices shall be allowed in overhead strain buses.

- 6.3 All horizontal ridged tube bus runs 1-1/2" IPS Aluminum or larger in excess of five feet (5') shall have damping conductor loosely installed, size as shown on the drawings.
- 6.4 Jumpers and buses shall be smoothly formed and adjacent runs shall be similarly and symmetrically shaped to provide a uniform pleasing appearance throughout.
- 6.5 All strain and rigid buses and all jumpers shall be cleaned of dirt, tags, marks, or tape or other material.
- 6.6 Utmost care shall be exercised in installing clamps, connectors, and other bolted devices. The contact surface of the clamp or connector and the bonding surface of the wire or tubing shall be clean and bright, and an oxide inhibitor shall be applied. A steel brush is recommended as the principal cleaning instrument.
- 6.7 Bolts shall be tightened firmly but threads must not be overstressed. Bolts in clamps over stranded conductor shall be tightened enough to flatten the lock washers, but not tight enough as to deform or damage the conductor.
- 6.8 Drill 1/4" diameter weep holes at low point of ridged tube bus run or at mid-span between bus supports.
- 6.9 All ridged tube bus ends shall be closed with corona free driven end caps.

7 ELECTRICAL CONNECTIONS

7.1 Aluminum to aluminum connections.

- 7.1.1 Bolts - aluminum alloy 2024-T4
- 7.1.2 Nuts - aluminum alloy 6061-T6
- 7.1.3 Two flat washers - aluminum alloy 2024-T4
- 7.1.4 Split lock washer - aluminum alloy 7075-T6
- 7.1.5 Torque requirements for lubricated aluminum bolts are as follows:

<u>Bolt Size - In.</u>	<u>Torque Ft lbs.</u>
1/2	25
5/8	40
3/4	60

7.2 Aluminum to copper connections.

- 7.2.1 Bolts - 18-8 stainless steel
- 7.2.2 Nuts - silicon bronze
- 7.2.3 Two flat washers - 18-8 stainless steel
- 7.2.4 Belleville washer - 17-7PH stainless steel. Washers shall be of sufficient gauge so they do not permanently deform after use.
- 7.2.5 All connections shall be tin plated. Bimetallic plates will not be allowed.

7.2.6 Arrange so that the copper or bronze is below the aluminum.

7.3 Copper to copper connections.

7.3.1 Bolts - 18-8 stainless steel.

7.3.2 Nuts - silicon bronze.

7.3.3 Two flat washers - 18-8 stainless steel

7.3.4 Belleville washer - 17-7PH stainless steel. Washers shall be of sufficient gauge so they do not permanently deform after use.

7.4 All mating surfaces shall be clean prior to installing bolted connectors. Oxide-inhibiting paste shall be used in making all aluminum-to-aluminum, aluminum-to-copper, and copper to copper connections. The paste shall be applied, the aluminum surfaces wire-brushed through the paste, and additional paste applied if necessary to cover the contact area. Paste remaining after connections are tightened shall be retained as a seal against moisture.

8 ALUMINUM BUS WELDING

8.1 Welding is to be performed by certified welders. Welding shall be in accordance with the procedures of the American Welding Society for gas shielded arc welding of aluminum.

8.2 Welds shall be made using the metal-arc inert gas (MIG) consumable electrode method of shielding arc welding. Use 4043 alloy electrodes.

8.3 Clean grease from surfaces to be welded with a solvent and remove oxide by scrubbing with a stainless-steel wire brush or stainless-steel scouring pad.

8.4 Insert tube fully into connector before making weld. If more than one pass is required, original weld shall be wire brushed.

END OF SECTION

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DIVISION 33 – UTILITIES

SECTION 33 79 00 – SITE GROUNDING

SECTION INDEX

1. General
 2. Related Sections
 3. Codes and Standards
 4. Ground Network
 5. Grounding
 6. Testing
-

1 GENERAL

This section covers the substation grounding system for structures, fences, and equipment.

2 RELATED SECTIONS

- Section 011000 – General Requirements
- Section 260543 – Trenching, Backfilling, and Grounding for Underground Raceways and Manholes
- Section 310100 – Site Work
- Section 323100 – Fences and Gates

3 CODES AND STANDARDS

- National Electric Code (NEC)
- National Electric Safety Code (NESC)

4 GROUND NETWORK

Provide a complete ground network of buried cables and driven ground rods sized and in locations and to depths shown on the plans.

- 4.1 Ground rods shall be Copperweld sectional type, threaded, 5/8-inch diameter, 10-foot long, depths as shown on the plans.
- 4.2 Ground cable shall be soft-drawn bare copper, sized as shown on the plans.
- 4.3 Splices in the ground cables shall be limited to an absolute minimum.
- 4.4 Install ground cables in trenches with sufficient slack to prevent breaking during backfilling or due to ground movement.
- 4.5 Buried connections as shown on the plan shall be made by the thermite welding process such as "ERICO" or "Cadweld". Mechanical connectors as manufactured by AMP Special Industries, Burndy or Thomas & Betts may be substituted if first approved by the Engineer. Install in strict accordance with the manufacturer's recommendations.
- 4.6 Leave connections and splices uncovered until inspection by the Owner or the Engineer. Backfill in accordance with Sections 310100 and 260543, thoroughly compacting the backfill material.

5 GROUNDING

- 5.1 Ground all steel structures and major equipment to the ground network as shown on the plans. Exposed ground cables on structural steel and equipment surfaces shall be secured by suitable clamps.

- 5.2 Ground fence corner posts, gate posts, gates, top rails, and barbed wire stranding to the ground network as shown on the plans.
- 5.3 Ground all switch operating handles as shown on the plans. Provide switch operator's grounding platform at each switch operating handle and ground at two points to the ground network, as shown on the plans.
- 5.4 Ground conduit systems using double locknuts, one inside and one outside, at equipment and box connections.
- 5.5 Ground liquid tight flexible conduit with a parallel copper jumper unless the conduit is equipped with a continuous integral ground strip.
- 5.6 Run #4/0 AWG stranded SD copper conductor the complete length of the cable tray system attached to the tray about every 10 feet, connect to the substation grounding system in at least two places.
- 5.7 Install a ground conductor the length of cable trench systems, using ground cable clips furnished with the cable trench, and connect to the ground network in at least two locations.
- 5.8 Install a ground conductor in the concrete envelope encasing underground banks of ducts. Connect the ground conductor to the ground network. Carry the ground conductor through manholes to provide a ground for cable supports, cable sheaths, etc. in the manhole. Install a ground rod at each manhole and bond the ground conductor to the rod.
- 5.9 Ground all equipment, conduits, switches, outlets, wiring devices and other equipment inside the control building in accordance with the NEC.

6 TESTING

- 6.1 The Owner/Engineer or other shall test the completed ground network. The contractor shall inform the Engineer when the ground grid is complete to coordinate testing.
- 6.2 The test shall be completed after all ground grid and ground rods are installed, but before it is connected to the distribution feeder grounds. It shall also be tested before the oil containment or stone surfacing is installed.
- 6.3 Measure the resistance of the ground network by the method described by Biddle for measurements of the resistance of an earth-electrode system covering a large area.
- 6.4 Submit a report listing equipment used, person(s) performing the test, date tested, sketch of the test set-up, and the test results.
- 6.5 If tests show that the resistance of the ground network is higher than required for the project, the Owner may authorize additional work.

END OF SECTION

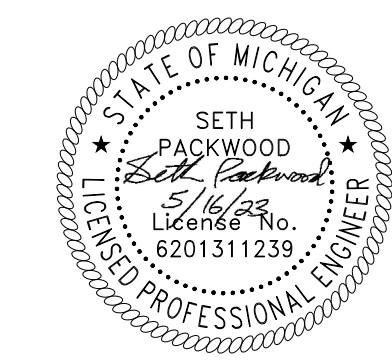
Irontown Substation

504 Peninsula St. Negaunee, MI. 49866

City of Negaunee

Drawing Title	Substation Acronym	Dwg. No.	Revision	Status	Rev Date	Revised Drawing By	Original Drawing By	PSE Issued for Bid	Individually Stamped by Others	Issued for Reference
Substation drawings										
Title Sheet Index	IRT	01-01	0	Bid	5/16/2023		PSE	X		
Site Plan	IRT	02-01	3	Bid	5/16/2023		PSE	X		
Site Survey Plan	IRT	02-02	1	Bid	5/16/2023		Coleman	X		
Grading and Erosion Control Plan	IRT	02-05	1	Bid	4/11/2023		SCS		X	
Grading and Erosion Control Details	IRT	02-06	1	Bid	4/11/2023		SCS		X	
Grading and Erosion Control Details	IRT	02-07	1	Bid	4/11/2023		SCS		X	
Fence Plan	IRT	02-10	0	Bid	5/16/2023		PSE	X		
Fence Details	IRT	02-11	0	Bid	5/16/2023		PSE	X		
Foundation Plan	IRT	03-01	1	Bid	5/16/2023		PSE	X		
Foundation Details	IRT	03-04	0	Bid	5/16/2023		PSE		X	
Foundation Details	IRT	03-05	0	Bid	5/16/2023		PSE		X	
Foundation Details	IRT	03-06	0	Bid	5/16/2023		PSE		X	
Conduit Plan	IRT	03-10	1	Bid	5/16/2023		PSE	X		
Conduit Details	IRT	03-11	0	Bid	5/16/2023		PSE	X		
Grounding Plan	IRT	03-20	1	Bid	5/16/2023		PSE	X		
Grounding Details	IRT	03-21	0	Bid	5/16/2023		PSE	X		
Oil Containment Plan	IRT	03-30	1	Bid	4/11/2023		SCS		X	
Oil Containment Details	IRT	03-31	1	Bid	4/11/2023		SCS		X	
Cable Schedule	IRT	04-01	0	Bid	5/16/2023		PSE	X		
Cable Schedule	IRT	04-02	0	Bid	5/16/2023		PSE	X		
Control Building Plan View	IRT	05-01	3	Bid	5/16/2023		PSE	X		
Control Building Ceiling Plan	IRT	05-02	0	Bid	4/11/2023		PSE	X		
Control Building Elevations	IRT	05-03	0	Bid	4/11/2023		PSE	X		
Control Building Bill of Material	IRT	05-04	0	Bid	4/11/2023		PSE	X		
Overall Plan View	IRT	06-01	1	Bid	5/16/2023		PSE	X		
Plan View	IRT	06-10	2	Bid	5/16/2023		PSE	X		
Profile Views A-A, B-B	IRT	06-11	0	Bid	5/16/2023		PSE	X		
15kV Metering Structure, Elevations C-C	IRT	06-12	0	Bid	5/16/2023		PSE	X		
Feeder Bay Elevation D-D	IRT	06-13	0	Bid	5/16/2023		PSE	X		
Feeder Bay Elevation E-E	IRT	06-14	0	Bid	5/16/2023		PSE	X		
Typical Riser Structure	IRT	06-15	0	Bid	5/16/2023		PSE	X		
Bill of Material	IRT	06-20	0	Bid	5/16/2023		PSE	X		
Bill of Material	IRT	06-21	0	Bid	5/16/2023		PSE	X		
Bill of Material	IRT	06-22	0	Bid	5/16/2023		PSE	X		
1-Line Diagram	IRT	10-02	2	Bid	5/16/2023		PSE	X		
3-Line Diagram Sht. 1 of 2	IRT	11-10	2	Bid	5/16/2023		PSE	X		
3-Line Diagram Sht. 2 of 2	IRT	11-11	2	Bid	5/16/2023		PSE	X		
3-Line Diagram Sht. 1 of 2	IRT	11-20	2	Bid	5/16/2023		PSE	X		
3-Line Diagram Sht. 2 of 2	IRT	11-21	2	Bid	5/16/2023		PSE	X		
AC Panel Wiring	IRT	19-01	1	Bid	5/16/2023		PSE	X		
DC Panel Wiring	IRT	19-02	0	Bid	5/16/2023		PSE	X		
RP1 Relay Panel Layout	IRT	22-01	0	Bid	5/16/2023		PSE	X		
RP1 Relay Panel Wiring	IRT	22-02	0	Bid	5/16/2023		PSE	X		
RP2 Relay Panel Layout	IRT	22-03	0	Bid	5/16/2023		PSE	X		
RP2 Relay Panel Wiring	IRT	22-04	0	Bid	5/16/2023		PSE	X		

Drawing Title	Substation Acronym	Dwg. No.	Revision	Status	Rev Date	Revised Drawing By	Original Drawing By	PSE Issued for Record	Individually Stamped by Others	Issued for Reference



PRELIMINARY
NOT FOR
CONSTRUCTION

				2424 Rimrock Rd, Suite 300 Madison, WI 53713 Tel: 866.825.8995				TITLE SHEET INDEX IRONTOWN SUBSTATION CITY OF NEGAUNEE, MI			
0	ISSUED FOR BID	GB	NH	05/16/2023	ENGR. N. HALL	CHIEF/APPD. S. PACKWOOD	SCALE NONE	PROJECT NO. M10592107	DRAWING NO. 01-01		
NO.	REVISION AND RECORD OF ISSUE	BY	ENGR.	DATE	DWN BY G. BODENSTEIN	DATE 12/28/2022	FILE NAME IRT-01-01				

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